

FORT RICHARDSON HEATED WATER PIPELINE STUDY

PRELIMINARY DESIGN REPORT

Prepared for:

**ALASKA DEPARTMENT OF FISH & GAME
SPORTS FISHING DIVISION**



Prepared by:

HDR ALASKA, INC.



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EXECUTIVE SUMMARY

Due to decommissioning of the Fort Richardson central heating and power plant, the fish hatchery operated by the Alaska Department of Fish and Game, Sport Fish Division (ADF&G) at Fort Richardson, needs a new long-term heat source for its water supply. The hatchery also needs additional sources of pathogen-free water to eliminate the need to reuse process water, a practice known to facilitate pathology links between different species and age groups of fish. This report summarizes the investigations and analyses performed to date for using waste heat from the Anchorage Municipal Light and Power (ML&P) Sullivan Power Plant (Plant #2) and developing a new well field in the deep aquifer near Plant #2 to secure sufficient sources of pathogen-free water. A conceptual plan for the project is contained in Appendix D. The purpose of compiling this report was to supply information to ADF&G for their use in evaluating alternative means to meet their program's stocking goals.

Studies show that Plant #2 has the potential to supply the heating needs of the hatchery as well as current ML&P and Anchorage Water and Wastewater Utility (AWWU) heat allocations; potential future AWWU allocations could be met most of the time. The ultimate success of the plan to use waste heat from Plant #2 to heat the hatchery process water depends on securing agreements that the heating needs of the hatchery will be met before those of AWWU, and that the hatchery needs would be second only to ML&P heating needs (e.g., to remove ice accumulation in the cooling tower).

The conceptual design proposes construction of a new heat exchanger building in the existing containment area for the abandoned fuel oil storage tank at Plant #2, cold-water pipelines from the new wells to a manifold vault and then in a single pipeline to the heat exchanger building. Heated water would be conveyed via a warm-water pipeline to the hatchery. The design includes controls for the well field and pipeline system, as well as for ML&P operations needs (emergency shutdown and regulating the amount of waste heat available for hatchery use). Communication system recommendations are made to ensure integration with the existing hatchery control system. The intent of the design was to develop a system that would be simple to operate and which would also provide flexibility to accommodate other potential users of ML&P waste heat.

Two separate wells assumed to produce 1,500 gallons per minute would be developed in a new well field. The location of these two well fields was selected to provide a sufficient separation between them and from AWWU supply well # 9 (next to Plant #2), but also allow them to use a water producing section of the aquifer. The cold water from the new wells would be combined in a manifold vault and then piped to the cooling tower in the newly constructed heat exchanger building. The cold-water pipelines would follow existing pipeline or utility corridors to Plant #2. The proposed alignment for the warm-water pipeline follows an existing, cleared utility corridor to the hatchery and is put forward as the best route from the heat exchanger building to the hatchery. To control flow and temperature, the heated water would be piped from the heat exchanger building to a blending tank at the hatchery. This blending tank will allow fine temperature adjustments to the process water by mixing it with cold well water from existing hatchery well system sources.

The construction of this project will require several environmental and right-of-way permits. We expect that the process of preparing an EA for work on Fort Richardson will be slower and more complex than it would be for work on civilian lands for a single federal agency. Because of the multiple agencies and work on military land, the process is likely to be more time consuming both in terms of hours spent and in elapsed time from start-up to a signed document.

The total estimated cost to permit, design, provide construction management, and construct is \$5,470,759. This includes a 25% contingency (\$1,094,152). The cost estimate includes demolition of the abandoned fuel oil storage tank at Plant #2.

PROJECT AUTHORIZATION AND SCOPE

The Alaska Department of Fish and Game, Sport Fish Division (ADF&G) contracted with HDR Alaska, Inc. under a professional service agreement (No. IHPC-03-002, dated March 6, 2003) to prepare a preliminary design report for the Fort Richardson heated water pipeline study. This report covers conceptual analysis and schematic design for building a heat exchange system, new pipelines, and the associated controls to convey groundwater from a new production well field to the Anchorage Municipal Light and Power (ML&P) power plant for heating and, from there, to the Fort Richardson Hatchery operated by ADF&G.

PROJECT BACKGROUND

At the Fort Richardson State Hatchery, ADF&G produces 1.7 million rainbow trout, 900,000 Chinook salmon smolts, 250,000 Coho salmon, 100,000 catchable Chinook salmon, 80,000 arctic char, and 100,000 arctic grayling for sport fishing management and enhancement throughout Southcentral and Interior Alaska. Pathogen-free water is integral to the fish production process. Currently, the hatchery uses on-site groundwater sources to supply water for these processes. However, because of the limited supply of high-quality water, the hatchery re-uses the process water several times, a practice that is known to facilitate pathology links between the different groups of fish. This is a continuing concern for hatchery personnel, and demonstrates the need for additional sources to supply pathogen-free water. After use, the process water is routed to a pond where it is treated before discharge to Ship Creek.

To promote fish production, groundwater from wells is heated from approximately 35-44 °F to 57 °F (2-7° C to 14° C). The current heat source used by the hatchery is waste heat from the heat exchanger at the adjacent U.S. Army Fort Richardson central heating and power plant. However, the Fort Richardson power plant is scheduled for decommissioning on October 31, 2003 as part of restructuring. Therefore, the hatchery is investigating new, long-term heat sources for the process water.

CONCEPTUAL ANALYSIS

The study began by investigating three alternatives for well field locations and proposed routes to bring the newly developed water source to the ML&P heat source and then into the hatchery. The work consisted of analyzing previous well field reports in the area of the proposed well field, obtaining preliminary base mapping for the area, investigating proposed alternative routes for the pipeline, researching potential areas with contamination along the proposed alignments, and compiling and interpreting temperature profiles from the ML&P heat source. Meeting notes from the various meetings of the involved parties are included in Appendix A.

Preliminary Hydrologic Research

Previous hydrologic assessments related to the hatchery well water supply included a review of existing geologic and hydrogeologic information (fall of 2000) and the exploration of subsurface conditions and limited aquifer testing (summer of 2002). An initial review of the subsurface hydrogeologic information in the well field vicinity and a preliminary assessment of the

horizontal extent of the aquifer were performed using the existing well log data. Subsequent test well explorations were conducted in June 2002 to determine the response at other wells and to fill data gaps. The study also gathered information about the nature and extent of the aquifer along a hypothetical well field corridor that exhibited favorable geology (greatest aquifer thickness).

The well field information for this water supply was previously submitted to ADF&G (“Evaluation of Pumping Test Data,” Shannon and Wilson, 2002), and is included as Attachment 1. The intent of this well field study was to investigate the nature and extent of the aquifer east of the Municipal Light & Power (ML&P) Sullivan Power Plant and to analyze the results of pumping tests performed at one of the test wells and at an Anchorage Water and Wastewater Utility (AWWU) water supply well (Well #9) located adjacent to the power plant. The subsurface information obtained from this field investigation suggests that a total of 1,500 to 2,000 gallons per minute (gpm) may be produced from a series of wells constructed within the project area. Based on this information, ADF&G decided to continue with an evaluation using this well water supply for the heated water pipeline evaluation.

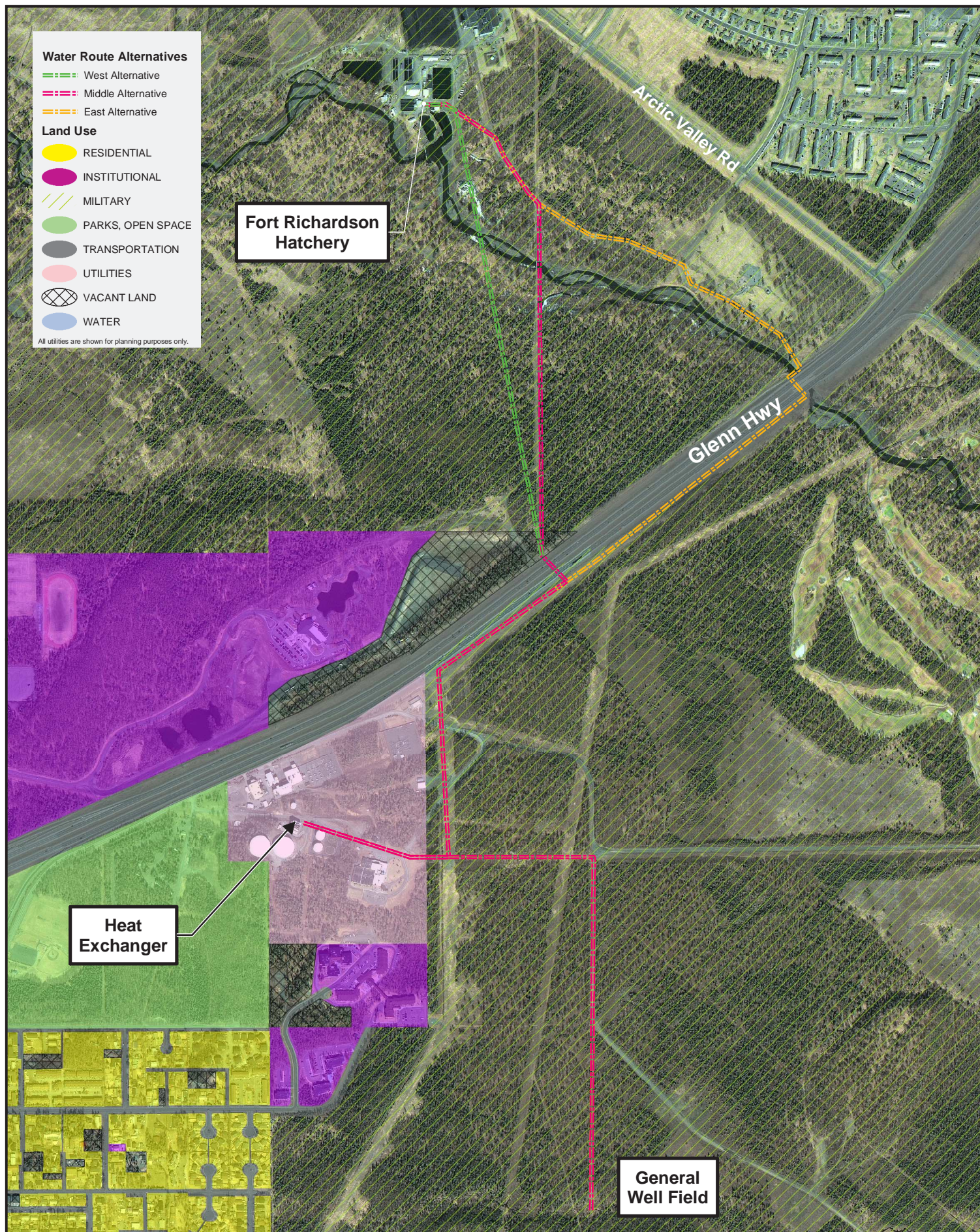
While the area aquifer shows a potential to have supplies available for the needs of the ADF&G hatchery, it is recommended that an additional assessment of aquifer conditions be performed in this area to evaluate the nature and extent of the aquifer, and determine if the well or well field would have any impact on AWWU Well #9 and other AWWU supply wells. Although this area apparently lies within the radius of influence of AWWU Well #9, it may be impractical to explore further south due to pipeline costs and encroachment upon other wells, or farther east or southeast due to pipeline costs and potential thinning of the aquifer.

Mapping, Topography, Utility, Property Information

Project corridors were evaluated using existing information. No new data collection surveys beyond walking potential alignments were made. Existing utility corridors, property owners, land-use mapping, delineated wetlands, right-of-way (ROW) mapping, and general area geology mapping were obtained from the following sources:

- Anchorage Municipal Light & Power (ML&P)
- Chugach Electric Association, Inc. (CEA)
- ENSTAR (gas)
- Department of Transportation and Public Facilities (ADOT&PF)
- Anchorage Water & Wastewater Utility (AWWU)
- Municipality of Anchorage, Department of Public Works (MOA DPW)
- Municipal Information System Department (MISD) of MOA
- Bureau of Land Management (BLM)
- United States Army

Figures 1, 2, 3, and 4 show the data collected from these sources. Delineated wetlands are not present along the pipeline alignments. The information gathered for the conceptual analysis is only preliminary and will require further analysis before preparation of project design.



April 2003
Fort Richardson Hatchery
Heated Water Supply

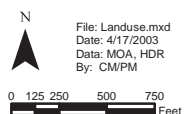
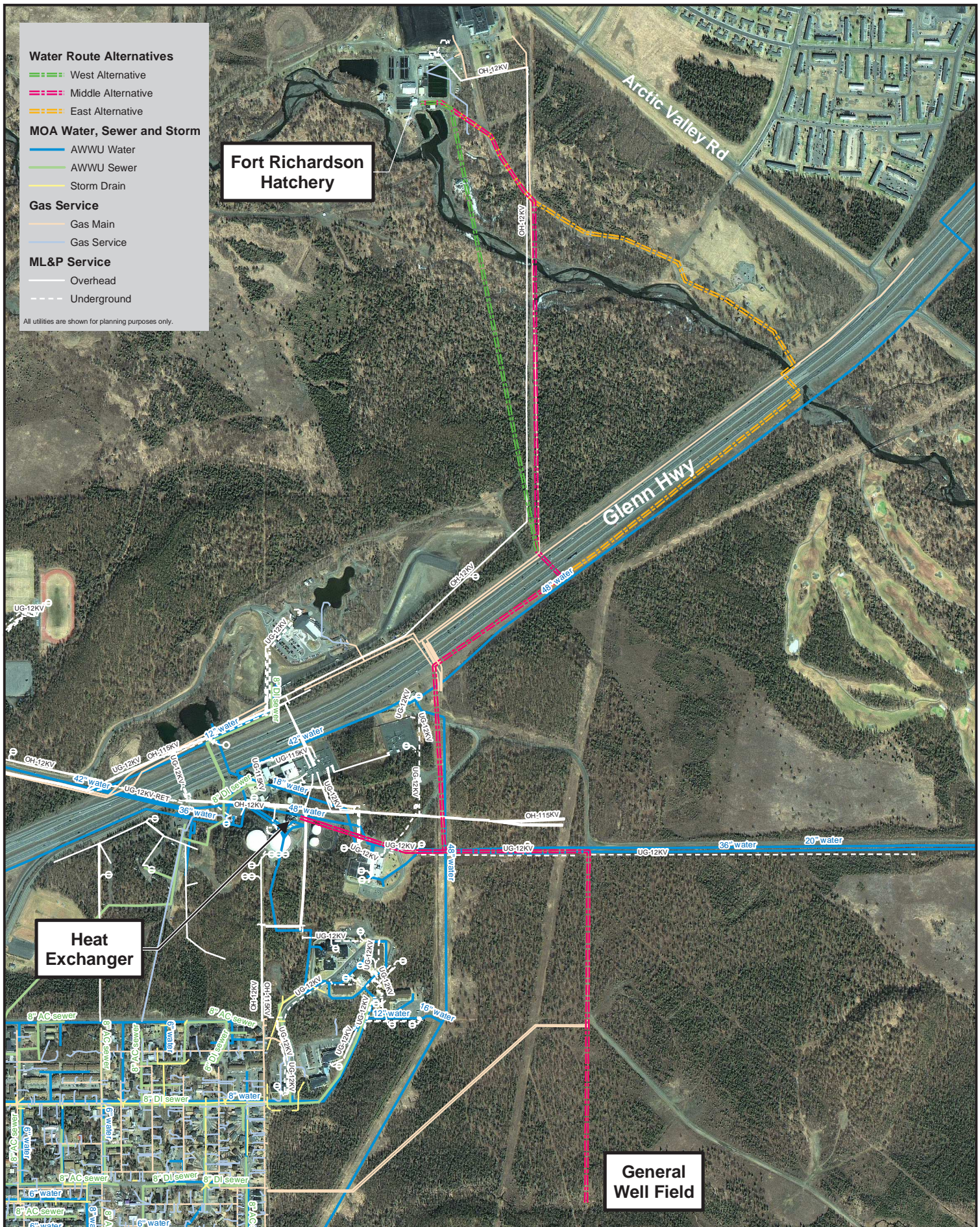
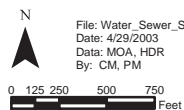


Figure 1
Land Use



April 2003
Fort Richardson Hatchery
Heated Water Supply



File: Water_Sewer_Storm.mxd
Date: 4/29/2003
Data: MOA, HDR
By: CM, PM



Figure 2
Utilities

Water Route Alternatives

- West Alternative
- Middle Alternative
- East Alternative
- Surficial Geology

All utilities are shown for planning purposes only.

Fort Richardson Hatchery

Heat Exchanger

General Well Field

Coarse-Grained Surficial Deposits

Acronym	Description	Type
af	Alluvial fans, cones and emerged deltas	C
al	Alluvium in abandoned channels and in stream terraces	C

Mixed Coarse- and Fine-Grained Surficial Deposits

Acronym	Description	Type
c	Colluvium (slope deposits)	M
f	fill in causeways and other large projects	M
gm	glacial and/or marine deposits, in elongate hills	M

Source:

Schmoll and Dobrovolsky. Surficial Geology of Anchorage and Vicinity, Alaska, U.S.G.S., 1972
Does not include information on peat in deposits at least 2 feet deep or areas with numerous manmade cuts and fills.

April 2003
Fort Richardson Hatchery
Heated Water Supply

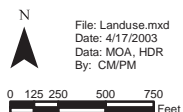


Figure 3
Surficial Geology

Water Route Alternatives

- West Alternative
- Middle Alternative
- East Alternative
- Contour Line

**Fort Richardson
Hatchery**

Glenn Hwy

**General
Well Field**

**Heat
Exchanger**

April 2003
Fort Richardson Hatchery
Heated Water Supply



0 125 250 500 750
Feet

File: Water_Sewer_Storm.mxd
Date: 4/29/2003
Data: MOA, HDR
By: CM, PM



**Figure 4
Topography**

Potential Soil Contamination

Two locations where spills of petroleum fuels have occurred in the vicinity of the ML&P power plant were identified. One location is due south of the power plant along an access road and east of two above ground storage tanks. The second location is on the north side of the power plant. The extent and nature of this possible soil contamination has not been researched. An assessment of potential environmental conflicts along the proposed route should be performed during the design phase of the selected project if a route through the MOA property is identified and suggested in the final design report.

Potential Pipeline Routes

Three potential pipeline routes were investigated (Figure 4; also Figure 1). The three alignments (East, Middle, and West) allowed evaluation of alternate paths from the proposed well field to the hatchery. All three alignments followed the same path from the proposed well field to the ML&P Power plant and from the power plant to the south side of the Glenn Highway. This was done because no other alignment opportunities exist in this area. At this point, the alignments deviate, with each following alternate paths for crossing the Glenn Highway and Ship Creek.

East Alignment

From the point where the alternatives diverge, the East alignment continues to parallel the Glenn Highway until reaching the Ship Creek highway bridge. The pipeline crosses the highway under the moose path (directly adjacent to Ship Creek) and hangs off the north side of the highway bridge to cross both the Glenn Highway and Ship Creek. After spanning the creek, the East pipeline would taper off the bridge and be buried, following the dirt road running from the Fort Richardson park to the hatchery.

Middle Alignment

The Middle alignment crosses the Glenn Highway near the location of the overhead electric line and underground gas corridor. Once across the highway, the Middle alignment runs along the existing cleared corridor for the overhead electric line and the gas supply lines running to the Fort Richardson power plant. The Middle alignment crosses Ship Creek near the pedestrian footbridge and continues to the hatchery buried under the gravel access road.

West Alignment

The West alignment crosses the Glenn Highway at the same location as the Middle alignment, but differs by taking the most direct path to the hatchery. This alignment is the shortest alignment, but requires the construction of a new easement and clearing through undisturbed BLM land.

Alignment Evaluation

A matrix was developed for the three alignments to evaluate and compare the alternate routes (see Appendix B). The matrix provided a scoring mechanism by evaluating several categories of the alignments, including clearing of corridors, utility conflicts, friction loss through piping, pipeline lengths, land ownership conflicts, highway and creek crossings, ease of obtaining permits, and constructability. The alternatives were compared by evaluating the accumulation of

points assigned for each category within the individual alignment. For example, the first category dealt with use of existing corridors; one point was assigned for alternatives that maximized use of existing corridors, while a zero was assigned to alignments that did not. The points for all of the categories were totaled for each alignment and compared. The matrix analysis found that the East alignment scored the highest number of points followed by the Middle then the West alignments. The one component that the matrix did not account for was the construction costs for the routes.

With the matrix analysis the West alignment was eliminated, but the Middle and East alignments were discussed further during a meeting with ADF&G representatives. After discussing the two alternate routes, ADF&G decided the Middle alignment was the best alternative for the schematic design.

The Middle alignment was chosen for continued investigation for two reasons. First, the route length of the Middle alignment (13,500 feet) was significantly shorter when compared with the East Alignment (15,875 feet), creating potential construction cost savings. Secondly, the East alignment would need the ADOT&PF to agree that the pipe could be hung from their Ship Creek bridge for the pipeline crossing over the creek and under the highway. These negotiations would require additional analysis, which would add the risk of project delay, as well as adding extra cost and time to the overall project.

AVAILABLE HEAT ANALYSIS

The heat for this project comes from the Anchorage Municipal Light & Power (ML&P) George Sullivan generating plant (Plant 2). The power plant produces hot water as a byproduct and normally dissipates the heat to the atmosphere at the cooling tower. In this project, the heat would be captured for the benefit of the fish hatchery. A building would be constructed to house a new heat exchanger to heat the water from the new well field.

Reliability of ML&P Cooling Tower Water

Plant #2, like any power plant, has planned outages for regular maintenance and unplanned, or forced, outages. The reliability of Plant 2 would directly affect the operation of the fish hatchery.

The power plant has three generating units. Unit 6 is a steam turbine with its own generator. Units 5 and 7 are gas turbines (similar to jet engines), each turning individual generators. Hot exhaust gasses from Units 5 and 7 are used to generate steam for Unit 6. As the steam passes through the turbine of Unit 6, it loses temperature and pressure. It is then condensed back to liquid water in the condenser. The condenser of Unit 6 is kept cool by the cooling tower. Hence, the cooling tower water is warmed by the operation of Unit 6.

Two issues affect the suitability of cooling tower water for the hatchery heating system. First, fluctuating water temperature causes a corresponding fluctuation in the amount of waste heat available. Temperature fluctuates hourly, but except for outages, it appears that there would always be adequate capacity for the heating needs of the hatchery (Figure 5). Other allocations of heat to AWWU are perhaps subordinate to the hatchery (see AWWU/ML&P Heat Exchanger

Cost Benefit Analysis, September 10, 2001, page 26). It is evident that these subordinate allocations (existing AWWU 75 MMBH¹ and proposed additional 75 MMBH heat exchangers, discussed below) would not always be met completely if the allocation to ADF&G has primacy.

Second, the cooling tower water is out of service for annual Plant 2 maintenance needs. Maintenance timing varies, although ML&P would not normally plan more than one unit out at a time. ML&P generally performs scheduled work on the various generating units during summer months.

- During normal years, the units are taken out of service for minor maintenance for a period of three to six weeks. When either Unit 5 or 7 is out of service, Unit 6 can still operate at reduced capacity. Unit 7 would provide about 2/3 of the maximum heat to Unit 6, and Unit 5 about 1/3 of the maximum heat to Unit 6.
- Every three years Turbine #7 is taken out of service for six to seven weeks for major inspections and refurbishment. During this period Unit #5 will normally remain online, allowing cooling tower water to be available at reduced capacity. The converse would be true when Unit 5 is out of service.
- About every five years the steam turbine (Unit #6) is taken out of service for six to eight weeks, and cooling tower water would not be available.

Outages, as mentioned above, are categorized as forced or planned. Frequency and duration of both categories are illustrated in Figures 5 and 6. During outages of the heated ML&P water, the boiler system at the hatchery would need to supply the hatchery heating needs. It seems apparent that the secondary boiler system would need to have the capability to react both to planned and forced outages.

Cooling Tower Water

Condenser water temperature data provided by ML&P was analyzed to understand the heat available for this project. These data were recorded by plant operators on an hourly basis over the period January 1, 2002 to June 24, 2003. The data represent the heat available in the condenser (cooling tower supply) water. Monthly graphs of the water temperature and its hourly fluctuations, represented as standard deviations from daily average, are included in Appendix C. A summary graph of waste cooling tower heat in BTUs (Figure 5), illustrates the heat available over the most recent 18-month study period.

¹ MMBH = million British thermal units per hour (BTU/h)

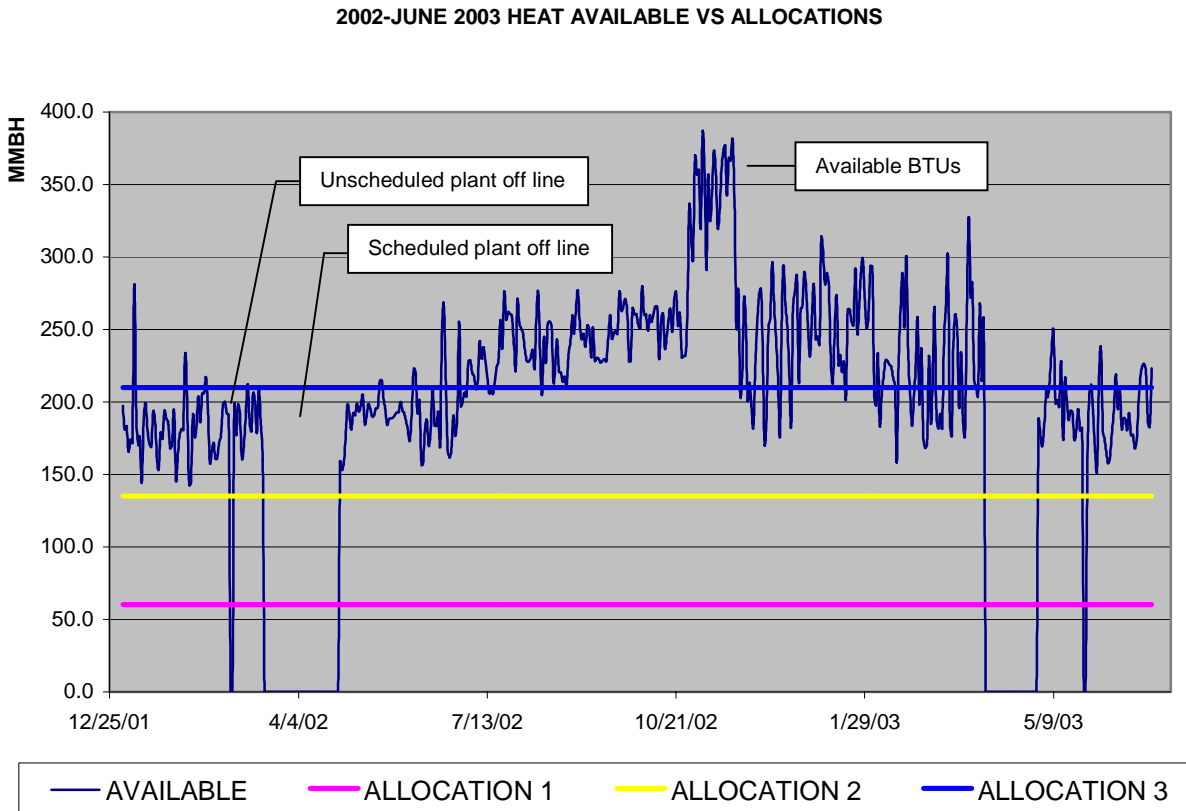


Figure 5. Heat Available Data for 2002 and 2003

In Figure 5, the primary or graph line indicates the total heat available, and fluctuates from zero to 400 MMBH (Y-axis) over the study period (X-axis). The three horizontal lines represent three allocations of the available heat.

- The lower allocation line, at 60 MMBH, is the heat required for the hatchery. Heat is adequate for the hatchery allocation anytime the graph line is above the 60 MMBH line.
- The middle allocation line, at 135 MMBH, represents the hatchery allocation of heat plus the existing 75 MMBH AWWU heat exchanger allocation. Heat is adequate for the both allocations anytime the primary line is above the middle line.
- The upper allocation line, at 210 MMBH, represents the hatchery and existing allocations, plus an allocation for a future second 75 MMBH heat exchanger for AWWU that has been proposed. Heat is adequate for all three allocations anytime the graph line is above the upper line.

Note that the condenser water temperature affects the operation of the heat exchanger. As can be seen from Figure 5, any time the plant is in operation, it produces ample heat to meet the hatchery allocation. However, once the water temperature drops below 83° F, it can no longer generate 81° F water for the fish hatchery. Also, if excessive icing occurs in the cooling tower during cold weather, warmer water is needed by the tower, which would reduce the amount of heat available for hatchery use. The cooling tower water averaged 89° F while operating over the period January 1, 2002 to June 30, 2003. The high month averaged 97.3° F and the low

month averaged 85.1° F. It should be noted that the 2002-2003 winter was warmer than the average, ranging from 14 degrees above normal in November 2002 to 1 degree above normal in March 2003. Further investigation of temperatures from colder years and their affect on heat supply should be completed before final design.

From the figure, it can be seen that the hatchery plus the existing AWWU heat exchanger allocation were reliably met, and the future AWWU allocation would be met a majority of the time. However, for the proposed project to succeed, the primacy of the hatchery needs with ML&P, over the AWWU allocations, should be firmly negotiated with MOA during the design phase of the project.

The reliability of Plant #2 as a heat source can also be described as availability percentages. Figure 6 contains six bar graphs depicting the availability of Plant #2 for the period January 1998 to June 2003. Plant #2 has averaged about 80% availability over this period. Appendix C contains additional data that compares the availability to the reason for the outage, either Planned (PO) or Forced (FO).

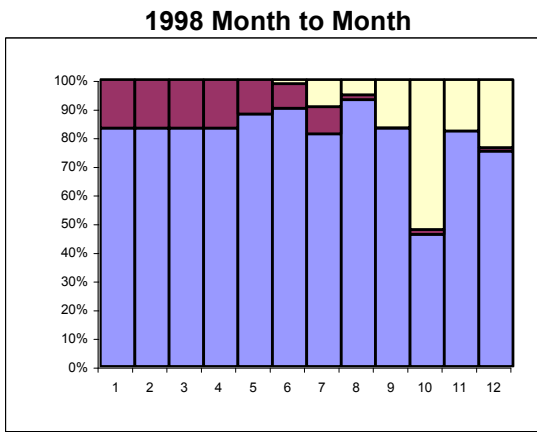
SCHEMATIC DESIGN

The second part of the project, after the preferred route was selected and heat availability determined, was to develop a schematic design of the selected route. The intent of the schematic design was to develop a system that would be simple to operate and provide flexibility to accommodate other potential users of ML&P waste heat. The schematic design contains pipeline and mechanical sheets. The topography and utility information gathered in the first phase was used to create plan and profile sheets of the proposed alignment. These drawings are attached in Appendix D. The schematic design of the route is shown on sheets C-01 through C-11. The conceptual mechanical design covers the waste heat exchanger system, heat exchanger building, and process controls. Sheet ME-01 presents a diagram of the overall system from the two production wells to the hatchery. Sheet ME-02 shows the control point schedule and the utility building plan layout. Sheet ME-03 presents the process and instrumentation diagram of the system. Engineering calculations used to develop the schematic design are located in Appendix E. The following sections describe the specific elements of the schematic design in more detail.

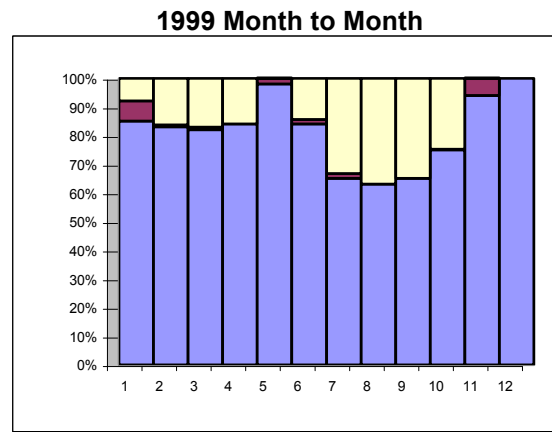
The schematic design was used to develop a cost estimate for constructing the system. To assist in the development of the cost estimate, the pipeline alignment was split into several sections: well field, pipeline from wells to well manifold, cold water pipeline to heat exchanger, and hot water pipeline to hatchery.

Well Field

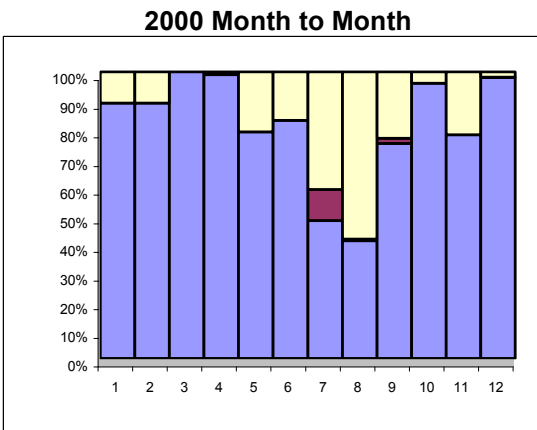
A well field system capable of producing 1,500 to 3,000 gpm is desired by ADF&G. Research into the hydrogeologic conditions from the first phase suggests that two new wells (1,500 gpm/each) may yield the desired groundwater production. Static groundwater levels in the area typically range from approximately 40 feet to 160 feet below ground surface (bgs). For the schematic design and cost estimate, ADF&G directed the project team to assume the installation of two new well fields approximately 2,825 feet to the southeast and east of the ML&P Power Plant #2 to a depth of 160 feet bgs, to produce a total of 3,000 gpm. The location of these two



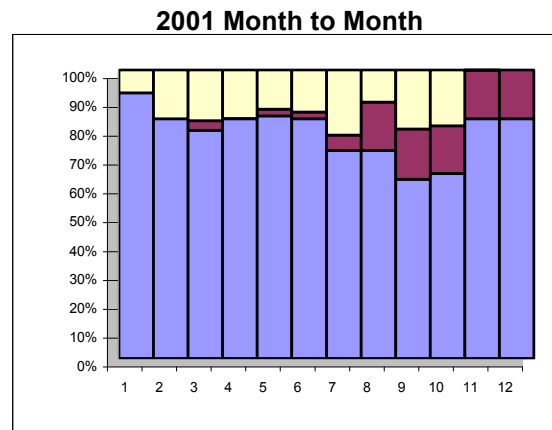
1998 Avg: Avail- 81% FO-10% PO-9%



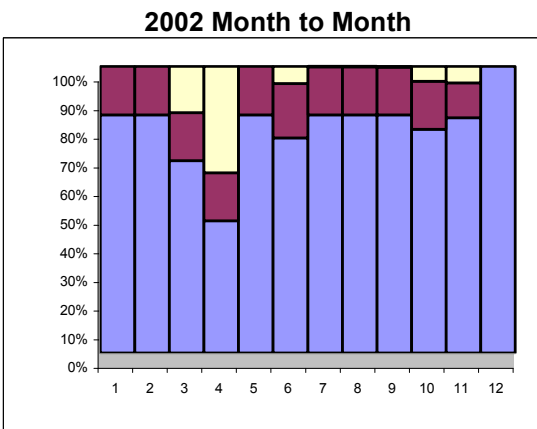
1999 Avg: Avail- 82% FO-4% PO-14%



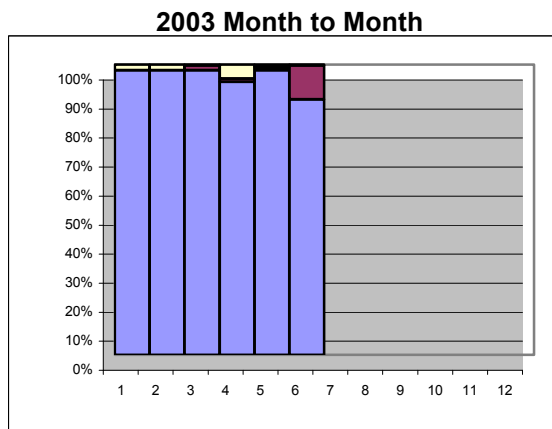
2000 Avg: Avail- 81% FO-2% PO-17%



2001 Avg: Avail- 78% FO-8% PO-14%



2002 Avg: Avail- 79% FO-17% PO-4%



2003 Avg: Avail- 96% FO-2% PO-2%

Avail - Available
FO - Forced Outage
PO - Planned Outage

LEGEND

- Percent Not Available due to Planned Outage
- Percent Not Available due to Forced Outage
- Percent Available

Figure 6

1998-June 2003 Plant 2 Availability & Types of Outages

wells was selected to provide as sufficient distance between the two proposed wells and AWWU Well # 9, while still using a producible section of the aquifer.

In addition to the above assumptions, the following design criteria were assumed to develop the well field schematic design:

- Two new 12-inch diameter wells installed at a depth of 160 feet bgs.
- One 110-horsepower (hp) submersible pump for each well to produce a maximum of 1,500 gpm at a maximum 150 feet total dynamic head and a maximum of 70 feet static lift.
- Submersible well pumps controlled using a variable speed drive.
- 12-inch diameter conveyance piping for each well.

Two identical 8 feet × 8 feet × 10 feet well vaults were placed at each wellhead to house controls and other instrumentation. Each vault will have a variable speed submersible well pump, discharge piping, heater, controls, lighting, ventilation fan, sump pump, and locking access hatch. The groundwater will be piped underground to a separate, centrally located well manifold vault.

Well Manifold Vault

Groundwater will be pumped from the two wells and combined at a centrally located well manifold vault. The mixed well water will be piped underground to a newly constructed heat exchanger building at ML&P Plant 2. A flow transmitter, check valve, and isolation valve will be provided for each well line in the manifold vault. The manifold vault will have a heater, controls, lighting, ventilation fan, sump pump, and locking access hatch similar to the individual well vaults.

Pipeline

The Middle alignment selected during the Conceptual Analysis phase of this work will have three segments: two production lines from the well field to the well manifold vault, a cold water line from the well manifold vault to the utility building, and a hot water line from the utility building to the hatchery. The following design criteria were assumed in the development of the schematic design for each pipeline segment:

- 12-inch (inside diameter [ID]) high-density polyethylene pipe (HDPE) for each segment from the individual wells to the well manifold vault.
- 18-inch ID HDPE pipe for the cold and hot water segments.
- Piping to be buried a minimum depth of 9 feet and a maximum depth of 12 feet to top of pipe.
- Insulation for pipe segments with less than minimum cover.
- Insulation between all pipes where the new groundwater line crosses over existing AWWU water lines.
- Single-pumper hydrants to provide air relief at the high points in the alignment.

- Directional drilling or boring and jacking operations 200 feet long each under Glenn Highway and Ship Creek.

Each pipeline segment is further described below.

Well Field to Manifold Vault

To obtain the desired water quantities, two wells will be required. The preliminary concept design sheets show the south well at the approximate location of test well number four. This location was selected because it provided the maximum distance away from AWWU Well # 9, minimizing the zone of influence for the well. For cost estimating purposes, the second well (east well) was assumed to be similar to the south well and the same distance from the manifold vault. As its location is not certain, it is not shown in the design sheets. Water from both of the individual wells will be piped underground to the central well manifold vault and mixed. The estimated length of the pipeline segment was assumed to be 2,825 feet for each well.

Cold Water Line

The second segment runs from the well manifold vault to the new heat exchanger building, which will house the heat exchanger and associated controls. This line will be sized at 18-inch ID to reduce friction losses in the line. The manifold segment will be 2,495 feet in length. The heat exchanger building is described in more detail in the heat exchanger section. There are several areas near the ML&P facilities where cold and hot water pipelines cross. Further investigation to the exact locations of the existing utilities should be completed before final design.

Hot Water Line

The third segment carries the heated water from the heat exchanger building to the hatchery. The segment is constructed from 18-inch ID HDPE pipe and is approximately 8,200 feet long. The pipeline leaves the utility building and runs along an AWWU water utility corridor until it reaches the Glenn Highway. The alignment then parallels the highway for approximately 1,500 feet to where it crosses under the highway. Directional drilling techniques will likely be required by ADOT&PF to cross the highway corridor and were assumed in this analysis. Starting at the north side of the highway corridor, the pipeline travels along an existing cleared corridor for an underground gas line to Ship Creek. There are also overhead electric lines along the corridor, which hang low in some areas. Caution will be required for construction in this area. For cost estimating purposes and the permit analysis, widening the corridor in this area was anticipated. The alignment will then cross under Ship Creek, again using the directional drilling techniques. The alignment will cross under the creek near the existing pedestrian footbridge. The pipe will be buried under the access road between the bridge and the dechlorination building at the hatchery.

Agencies were contacted to discuss the alternative of open trenching for the creek area. An open cut crossing was not well received, but may be a negotiated alternative in final design. Directional drilling, however, was assumed for the schematic design. Installing the pipeline with an open cut under ship Creek should be investigated during project permit negotiations.

Hatchery Building

The water arriving at the hatchery in the pipeline will likely have some variability in both temperature and flow. To accommodate these changes into hatchery processes, the heated water will be blended with other well water at the hatchery. An addition to the dechlorination building is anticipated to house a 6,000-gallon blending tank, where the pipeline will discharge. The blending tank will allow fine temperature adjustments to the process water, depending on production needs.

Heat Exchanger Building

The heat exchanger building at ML&P will provide the heat necessary for hatchery production needs. As shown on sheets ME-2 and ME-3, the building will contain a plate-and-frame heat exchanger, dual vertical inline centrifugal pumps, an overhead beam crane or gantry crane, valves, controls, and a controls system. The building was assumed to be 24 feet by 32 feet to house the heat exchanger and associated controls and piping. The following design criteria were assumed for the heat exchanger:

- 3,500 gpm design flow rate (entering heat exchanger at 41° F, and leaving heat exchanger at 81° F max)
- Heat Exchanger Capacity: $500 (3,000 \text{ gpm}) (81^{\circ}-41^{\circ}) = 60 \text{ MMBH}$
- ML&P Cooling Tower Water: Varies 85° - 100° F entering temperature; 3,425 gpm
- Line taps sized for future additional 5,700 gpm for possible future AWWU needs

To provide heated water for the heat exchange system, a loop made of two 24-inch, 60-foot long ductile iron pipes will provide the tap (or bypass) and return into the existing 36-inch ductile iron pipe at the ML&P facility. The tie-in was sized to accommodate hatchery needs and possible use by AWWU, as requested by ML&P staff. AWWU may locate a heat exchanger building adjacent to the proposed hatchery heat exchanger building in the future.

This conceptual design is very similar to the conceptual design presented in the 1999 and 2000 heat exchanger reports that were prepared for AWWU (AWWU, 1999 and 2001)—with one significant difference. The previous concepts indicated that the cooling tower water would be taken from the 36-inch cooling tower supply line, cooled by the heat exchanger, and then discharged into the cold sump of the cooling tower, which would affect the condenser water temperature controls. Under the current concept, the warm (85°-100° F) cooling tower supply water would be directed through the bypass, cooled by the heat exchanger for the hatchery, and then reinjected immediately downstream of the bypass for additional cooling in the ML&P cooling tower. This approach would result in no changes to the pressures and flow rates in the cooling tower system. The temperature of the water arriving at the cooling tower would be lower, but it is anticipated that the existing temperature controls would be able to continue to operate with only minor, if any, programming changes.

The system is designed to use approximately 3,425 gpm of the cooling tower water to heat the 41° F well water. The well water must arrive at the hatchery at about 75° F. Due to temperature losses in the pipeline, it is expected that the well water must be heated to 81° F at the utility building. This heating requires approximately 60 MMBH of thermal energy. The concept

design shows that the future needs of AWWU have been taken into consideration. The drawings show a pair of 24-inch pipes connecting to the cooling tower line, which will be made available above-ground to AWWU in the heat exchanger building for future connection. The anticipated total cooling tower flow to be used by AWWU is 5,700 gpm, as indicated in the AWWU / ML&P Heat Exchanger Cost Benefit Analysis (2001).

The location of the heat exchanger building was an important consideration in this project. Four possible sites were considered, and with input from ML&P, it was decided that the location in the existing containment area for the abandoned fuel oil storage tank would be the ideal site. At this location, the connections to the cooling tower line would be accessible, the utility building would be easy to access, well water pipe installation would not involve removal and reinstallation of fencing or piping, and there is sufficient room for an AWWU utility building adjacent to the hatchery heat exchanger building. According to ML&P, the abandoned fuel oil storage tank may be demolished as part of this project, or earlier if done by ML&P. The cost of tank demolition has been included in this project cost estimate.

Power

Both of the water well vaults, the manifold vault, and the utility building will require a reliable power source. There is a buried 12kV distribution line at the southern well location and manifold vault sites, so providing power to them and the utility building will be an extension of these lines. The eastern well location will require new buried distribution lines. Due to the proximity of the well vaults and heat exchanger building to the power plant, and the inherent reliability of the power, a backup power system was eliminated from the concept design. The U.S. Army may require that the transformer, meter, and all other components at the well and manifold vaults be below grade. This issue should be evaluated in final design.

Controls and Communications

The heated water pipeline system will require a reliable control system. The control system should be designed around the Allen Bradley SLC 50/04 PLC controllers for seamless integration with the existing hatchery control system. The system will use various pressure transmitters, temperature transmitters, flow transmitters, aquifer level monitoring sensors, and motor-operated valves to provide fully automated operation. Touch-screen graphic panels and emergency shutdown pushbuttons will also be provided for operator interface.

Communications between the well vaults, manifold vault, utility building, and hatchery PLCs will be by direct-bury fiber optic cable. The cable will be installed in the same trenches as the water pipe. Other communications methods, such as radio frequency and microwave, were considered, but they proved to be much less reliable than fiber optics.

Under the concept design, two control points will be provided for use by ML&P. One will be a digital permissive signal that will allow ML&P to completely shut the system down, manually or automatically, in the event of unplanned system trouble at the power plant. The other will be an analog signal that would allow ML&P to limit the heat used by the hatchery system. For example, if the cooling tower experiences excessive icing in cold weather and requires warmer water, ML&P will have the option of reducing the hatchery use. With the available serial

communications, ML&P will also have the ability, if desired, to monitor the entire system with low-level access.

System Integration

Currently, the hatchery uses waste heat from the cooling pond of the adjacent military power plant to heat water from local wells. However, the power plant is scheduled to be decommissioned before November 2003. Due to an immediate need for a new heat source, ADF&G intends to install a new boiler system to heat the process water before the power plant is decommissioned. The boilers will be used full time as the primary heat source until a long-term heat source is developed, and then as a backup source after the heated water pipeline is constructed.

The heated water pipeline will deliver water to the hatchery at approximately 75° F. The heated water will then be blended down to a precisely controlled lower temperature. Construction of a new blending tank is anticipated to achieve the precise temperature control. A bypass line with motorized control valve will be installed to reject unheated water during the startup sequence of the heated water system.

Due to the need for precise water temperature control, reliable automated operation, and redundancy, the heated water pipeline and its controls will have to be carefully integrated with the existing hatchery systems. All new control components shall be selected to match existing components to ensure a standardized system.

Because the hatchery water supply cannot be disrupted for any length of time during construction, the supply system will need to have a supply bypass in-place prior to completing the final tie-in to the hatchery supply line. This bypass should involve having the new system operational to the hatchery sump for warmed well water or to a new pre-mixing heated storage tank. This bypass will supply the necessary heated water while the final tie-in piping is completed. It is anticipated that the new interim boiler system built at the hatchery will serve as an emergency heat source as well as during the calibration of the new heated supply water system.

Permitting Considerations

Before a federal agency can take a major action, such as issue a permit for construction on federal land, the project must be reviewed under the National Environmental Policy Act (NEPA). Unless the project is routine and its implementation is sure to not cause significant environmental impacts, an environmental assessment (EA) must be prepared. The EA will determine whether or not the project would result in significant environmental impacts. The BLM, as manager of Fort Richardson lands, will be the lead federal agency for preparation of the EA, and the EA must be prepared according to BLM regulations and procedures.

We expect that the process of preparing an EA for work on Fort Richardson will be slower and more complex than it would be for work on civilian lands for a single federal agency. Both BLM and Fort Richardson staff will be heavily involved in information analysis, and in the decisions made during the process. The BLM and Fort Richardson may have conflicting opinions on the process. Access to the site and to information may be more difficult than for a project on

non-military lands, and meetings will be more difficult to schedule. Interim document reviews are likely to require long periods of time. Issues specific to military lands will need to be addressed, and heightened security awareness may lead to unusual requests for analysis or mitigation measures.

Conversations with three separate entities that have recently worked with BLM to prepare NEPA analyses, including two which analyzed projects on military lands, indicate that the NEPA process is likely to be more time consuming than normal, both in terms of hours spent and elapsed time from start-up to a signed document. Preparation of an EA can cost anywhere from \$10,000 to \$500,000, depending on project complexity, level of controversy, issues, and lead agency requirements. Costs for a typical EA range from \$50,000 to \$100,000. For the reasons described above, preparation of an EA for the Fort Richardson hatchery water line is likely to require more effort than a typical EA, even though there do not appear to be substantial or controversial environmental issues. The estimated cost is \$150,000.

COST ESTIMATE

Using the outlined conceptual design for the Middle alignment as described above, a project cost estimate was developed. The total estimated cost to permit, design, provide construction management, and construct is \$5,470,759. This includes a 25% contingency (\$1,094,152). The table below shows the break down of cost and Appendix F contains the complete detailed itemization for the cost estimate. In developing this conceptual level cost estimate, the estimate was divided into three major categories:

- Facility Cost
- Pipeline Cost
- Site Electrical & Communication Cost

Facility costs were associated with the two new production wells, the well manifold vault that combines flows from the two wells, the new heat exchanger utility building, and the tie-in at the hatchery. The pipeline costs were broken into three components: general construction site preparation, buried HDPE conveyance pipe, and buried ductile iron pipe for the tie-in loop at ML&P. Site electrical and communication costs included power lines, controls, communications, monitoring systems, and related items.

Cost Summary Table

Project Component	Estimate	Contingency	Total Cost
Facilities	\$ 1,110,745	\$ 277,686	\$ 1,388,431
Well No. 1	\$ 198,641		
Well No. 2	\$ 198,641		
Manifold Vault	\$ 61,428		
Heat Exchanger Building	\$ 578,280		
Hatchery Tie-in	\$ 73,754		
Pipeline	\$ 2,264,355	\$ 566,089	\$ 2,830,444
General Site Set-up	\$ 551,167		
HDPE Pipeline	\$1,608,571		
Buried Ductile Iron Piping	\$ 104,617		
Electrical & Communications	\$ 243,127	\$ 60,782	\$ 303,909
Electrical Power Distribution	\$ 170,859		
Fiber Optics	\$ 72,268		
Engineering	\$ 758,380	\$ 189,595	\$ 947,975
Engineering Design	\$ 434,187		
Construction Management	\$ 324,193		
	\$ 4,376,607	\$ 1,094,152	\$ 5,470,759

Several assumptions were made in developing these costs. The first assumption was the 25% contingency applied to the overall cost to account for the conceptual design level of the project. This allows for unforeseen adjustments that may be needed during final design. The other assumptions were estimating 12% of construction cost for engineering design, and 8% of construction cost for construction management. Additionally, it was assumed that the contractor's overhead would be 8%, home office expense would be 5%, the contractor's profit would be 10%, and a 1% cost would be associated for bonding the project.

Cost Savings from Heated Water Pipeline

Assuming operation of the system for eleven months per year under a full load of 60 MMBH, the system will use 4.82×10^{11} BTU annually. Using a current natural gas rate of \$2.88 per MBH, this

equates to an annual savings to ADF&G of approximately \$1.73 million. However, negotiated bulk gas rates may reduce this number by up to 50%.

Also, assuming operation of the system for eleven months per year under a full load of 60 MMBH, the cooling tower makeup water load will be reduced by up to 69,000 gallons per day. Using a rate of \$0.10 per 1,000 gallons, this equates to an annual savings to ML&P of approximately \$2,300.

REFERENCES

Anchorage Loop WTM Thermal Analysis. January 27, 1998. Prepared by Montgomery Watson for AWWU.

AWWU/ML&P Heat Exchanger Cost Benefit Analysis. September 10, 2001. Prepared by Coffman Engineers, Inc. for AWWU.

AWWU/ML&P Plant 2 Heat Exchanger Upgrade Feasibility Report. December 15, 1999. Prepared by Coffman Engineers, Inc. for AWWU.

Shannon and Wilson, Inc. December 11, 2002. Evaluation of Pumping Test Data, proposed Fort Richardson Fish Hatchery Well Field, Anchorage, Alaska.

Record Drawings

AWWU Anchorage Loop Water Transmission Main, Phase I. 1998.

AWWU Eklutna Water Project Phase I. 1984.

AWWU 36 Inch Transmission Main Diversion Dam to W.T.P. 1980.

Contacts

Anchorage Municipal Light and Power (ML&P)

Jim Caress, Ed Reubling, Bob Day, Will Palmeroy, Kurt Julsen, Dennis Schouweiler, Mark Best

Anchorage Water and Wastewater Utility (AWWU)

Roberta Piper, P.E., Bill Putnam

HDR Alaska, Inc.

John Nelson, Dan Billman, Jennifer Gastrock, Anne Leggett, Amy Hansen

Coffman Engineers, Inc.

Walter Heinz

Shannon and Wilson

Bill Burgess, John Spielman

ADF&G Division of Sport Fish

Gordon Garcia, Jeff Milton

Appendix A
Meeting Notes

ADF&G Meeting – April 30, 2003

Alaska Dept. of Fish, Game & Transportation Fort Richardson Heated Water Pipeline Study Agency Meeting, April 30, 2003

Attendees:

ADF&G:

Gordon Garcia, Project Manager 907.465.2772

Jeff Milton, Regional Hatchery Supervisor 907.267.2523

HDR:

Dan Billman, Engineering Manager 907.274.2000

John Nelson, Project Manager 360.871.2727

Jennifer Gastrock, Staff Engineer 907.274.2000

ML&P:

Jim Caress, Generation Superintendent 907.263.5303

Bob Reagan, Regulatory Affairs Supervisor 907.263.5413

AWWU:

Roberta L. Piper, P.E., Civil Engineer 11 907.564.3898

Meeting with ADF&G, AWWU and ML&P:

Presented a summary of the project and its purpose to MLP and AWWU at overview.

ADF&G has to by 2005 switch to heated source because of closure of Ft. Richardson power plant.

ADF&G will be preparing a 20-year hatchery plan in the near future and the decision on how to address long term heat issues will be part of that plan.

All present discussed feasibility of current proposal.

Jim asked about past heat study that AWWU conducted. Roberta said she does not know where study is, due to personnel changes at AWWU.

Jim asked Roberta AWWU's heat needed. Roberta did not have that information although she said the study would have the best information

Jim said Well #9 used for cooling use by ML&P.

Jeff asked about ML&P reducing the amount of cooling water over time. MLP stated their plan was to continue operation as is currently done.

Roberta stated AWWU would be concerned with several issues in the waste heat pipeline project. These are:

Waste heat availability for AWWU.

Settlement of AWWU raw and treated water pipelines due to uninsulated warm water pipe creating a thaw bulb.

ADF& G Meeting – April 30, 2003

The 48" Eklutna Water Transmission water pipe very sensitive issue to AWWU as it is the primary water supply for Anchorage.

AWWU will likely require 2' min. separation between pipes.

AWWU will likely require 25' horizontal separation on water lines.

ML&P said that the agreement between AWWU and MLP has 18 months left and will need to be renegotiated. (Fink administration era agreement)

Coffman did waste heat study and they will try to locate copies.

AWWU takes heat downstream of ML&P cooling tower.

Is there enough heat for everyone to share – Jim/Bob said, yes, plenty.

ML&P has a 6 typical week outage in summer for generator maintenance.

Bob Reagan – ML&P have emergency power if required by ADF&G

Bob Reagan stated that the heat is not free for ADF&G. ML&P by RCA regulations has to establish a cost for the heat and then a rate that ADF&G will need to pay. This could be minimal and is negotiable between MOA and ADF&G.

Roberta asked for a copy of the report to review. Gordon said she would be given a copy.

Timeline is to be finished by June 30.

Preliminary pipe alignment was outlined as follows:

Along highway.

2 paths:

- (1) Down gas line corridor – under hwy. - \$375/foot + 20,000 jack pit.
- (2) To bridge – cross bridge.

Depth of burial

10' BOP – 15 max.

A discussion of the agencies that will evaluate or permit the project followed and a preliminary list established. The agencies listed were:

AWWU.

BLM

ADOT – confirm rd, crossing permits.

MLP

ADF& G Meeting – April 30, 2003

All agreed that ADF&G should not spend a years permitting.

Open cut at the Ship Creek Crossing was discussed.

Widening the corridor through the BLM administered area on Ft. Richardson was discussed. It was noted that BLM would require EA – EIS and Rodney Huffman at BLM will likely lead the process.

Alignment may go through a diesel spill area. An environmental audit should be done.

It was noted that there might be environmental issues on Fort Richardson lands.

Alaska Dept. of Fish, Game & Transportation
Fort Richardson Heated Water Pipeline Study
Kickoff Meeting, April 30, 2003

Attendees:

ADF&G:

Gordon Garcia, Project Manager 907.465.2772

Jeff Milton, Regional Hatchery Supervisor 907.267.2523

HDR:

Dan Billman, Engineering Manager 907.274.2000

John Nelson, Project Manager 360.871.2727

Jennifer Gastrock, Staff Engineer 907.274.2000

Coffman Engineers:

Eric Jensen, Project Engineer 907.276.6664

Tim Peters, Electrical Engineer 907.276.6664

Shannon & Wilson Associates:

Bill Burgess, General Geotech 907.561.2120

John Spielman, Hydrogeology 907.561.2120

Introduction:

HDR – John Nelson

Project Intent – The intent of this work is to develop a new source of pathogen free, heated water supply to the FRH with sufficient capacity to meet existing production needs.

Purpose of meeting – This meeting is to introduce team members and discuss specific tasks and potential concerns relevant to this project.

Pipeline Alignment – Two alignments are being evaluated as possible routes to hatchery. Alignments were selected based upon trying to use existing utility corridors. The two pipeline alignments were similar from started at test well #4 to the ML&P facility to be heated, and finally a point along the Glenn Highway where the two pipelines change alignments. The East alignment continues along the highway to the highway bridge, then under bridge, across Ship Creek, through the park and along the dirt access road to the hatchery. The West alignment continues from the south side of Glenn Highway under the Highway to the north side and continues following gas easement north across Ship Creek to dirt access road leading to hatchery. The two pipelines both utilize existing utility easements.

The main issues for the two pipeline alignments were crossing highway, and crossing Ship Creek. These will be discussed later.

Groundwater Study Findings:

Shannon & Wilson Associates – John Spielman, and Bill Burgess

Historical Data –

Assessment of Groundwater – From two previous field investigations, it appears that aquifer may not yield 3,000 gpm, but rather approximately 1,500 gpm. Confined aquifer blends with unconfined aquifer as the two layers approach the mountains. Recommend further investigations to determine aquifer yield and impact on AWWU Well # 9 while it is in operation and the test well in well field is operating. Gordon said that this work may occur this summer under separate contract.

Geotechnical Literature Review – Bill has reviewed alignments and is unaware of any outstanding abnormalities with geology in area. Bill did mention that there may be varying conditions, but most contractors in area have worked in similar environment and would be prepared for changing conditions. Bill thought that material under highway could yield very large cobbles and that a minimum of 24” casing for jacking would be minimum casing recommended size. Bill was going to review other geotechnical data on Glenn Highway and other areas within project area.

Hazardous Materials along Alignments Review – Bill has reviewed alignments and is unaware of any outstanding Hazardous areas with the exception of the ML&P facility and AWWU’s facility. Bill has general knowledge of gasoline/diesel spill, but not other constituents known to be present. Gordon and Jeff both discussed possible groundwater contamination found in AWWU’s well #9. Bill and John were going to review past records if available.

Heat Exchanger / Temperature Profiles:

Coffman Engineers – Eric Jensen, and Tim Peters

Cooling water from ML&P facility ranges between 90 to 100 °F (32.2 to 37.8 °C).

HDR calculated an initial pipeline temperature drop of 6 °F.

Eric met with Jim Caress and discussed project. ML&P are very interested in project.

ADF& G Meeting – May 29, 2003

Alaska Dept. of Fish, Game & Transportation Fort Richardson Heated Water Pipeline Study Kickoff Meeting, May 29, 2003

Attendees:

ADF&G:

Gordon Garcia, Project Manager 907.465.2772

Jeff Milton, Regional Hatchery Supervisor 907.267.2523

HDR:

Dan Billman, Engineering Manager 907.274.2000

John Nelson, Project Manager 360.871.2727

Jennifer Gastrock, Staff Engineer 907.274.2000

Coffman Engineers:

Eric Jensen, Project Engineer 907.276.6664

Tim Peters, Electrical Engineer 907.276.6664

Introduction:

Jen – gave overview of plan/profit sheets.

Gordon stated he will supply hatchery area as-builts on AutoCad.

*Jeff and Gordon discussed the need for to mix the incoming water prior to use. HDR was directed to estimate a building addition and a warm water sump.

Need alternate discharge point before entering heat exchange building at hatchery so a bypass will be added to concept design. The bypass will discharge to power plant pond.

Eric (Coffman) described mechanical and electrical components he thought would be needed. These included

- Fiber optic cable
- All under ground vault
- Vault rain
- Transformer subsurface
- Cost of drop power
- Remote monitoring of power
- Verify variable speed drive motor on submersible
- All vault to be vented/heated/sump pumps
- Assume ventilation required at each vault
- Verify use of galvanized pipe at heat exchanger for corrosion control

Dan discussed 24" tie-in for AWWU and it was decided to assume tie into ML&P hot water line would serve both ADF&G and ASSU in the future.

ADF& G Meeting – May 29, 2003

Jeff mentioned expansion joints might be required on DI or other steel pipe.

Need isolator for AWWU hot water from ADF&G use.

110hp pumps any be required at the wells.

Heat exchanger only cools water, no pressure or other impacts to the ML&P cooling water.

Coffman will verify temperature range at ML&P. It is believed to be 90-100 deg. F.

Use parallel basket strainers at heat exchanger on incoming well water.

Use single heat exchanger for ADF&G.

Cleaning exchanger will be minimized through use of strainers. Maximum flow to help clean exchanger.

ADF&G agreed that HDR should assume the heat exchanger building should be 24' x 32'.

40 hp process side pumps may be required to circulate the cooling water through the heat exchanger.

ML&P would like to locate the heat exchanger building at fuel tank location. The tank will be removed shortly.

HDR will get the Glenn Highway as-builts on drawings to determine the jacking distance.

In-line blending vs. tank blending was discussed. It was decided to do assume tank blending and that will require a new building.

Assume 6000 gallon tank blending tank for estimate.

Appendix B
Alignments Matrix

**Alaska Department of Fish & Game
Fort Richardson Heated Water Supply Pipeline**

Factors that impact Alignment	Pipeline		
	West	Middle	East
Utilizing existing utility cleared corridors	2	5	5
South side of Glenn Highway	1	1	1
Crossing Glenn Highway	1	1	1
North side of Glenn Highway	0	1	1
Crossing Ship Creek	0	1	1
Ship Creek to Hatchery	0	1	1
Minimal conflict with existing utilities	3	2	4
South side of Glenn Highway	0	0	0
Crossing Glenn Highway	0	0	1
North side of Glenn Highway	1	0	1
Crossing Ship Creek	1	1	1
Ship Creek to Hatchery	1	1	1
Anticipated pipeline least head loss	1	3	2
Length of route	2	1	3
Minimal conflict with landowners/tenants	3	4	5
South side of Glenn Highway	1	1	1
Crossing Glenn Highway	0	0	1
North side of Glenn Highway	0	1	1
Crossing Ship Creek	1	1	1
Ship Creek to Hatchery	1	1	1
Simplicity of Crossing Glenn Highway	0	0	1
Simplicity of Crossing Ship Creek	0	1	1
River meander control at crossing	0	0	1
Ease of Permits	0	0	1
General Ease of Constructability	3	3	5
South side of Glenn Highway	1	1	1
Crossing Glenn Highway	0	0	1
North side of Glenn Highway	1	0	1
Crossing Ship Creek	0	1	1
Ship Creek to Hatchery	1	1	1
Scoring Summary	14	19	28

Appendix C
Data Collected from ML&P
(included on attached CD)

Appendix D

Schematic Design Drawings

Appendix E

Engineering Calculations

From Well # 1 to Manfold
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\frichpi.fm2
Worksheet	From well# 1 to manifold vault
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data	
Pressure at 2	23.03 psi
Elevation at 1	287.00 ft
Elevation at 2	301.00 ft
Length	2,825.00 ft
C Coefficient	150.0
Diameter	12.00 in
Discharge	1,500.0 gal/min

Results		
Pressure at 1	34.15	psi
Headloss	11.65	ft
Energy Grade at 1	366.05	ft
Energy Grade at 2	354.40	ft
Hydraulic Grade at 1	365.77	ft
Hydraulic Grade at 2	354.12	ft
Flow Area	0.79	ft ²
Wetted Perimeter	3.14	ft
Velocity	4.26	ft/s
Velocity Head	0.28	ft
Friction Slope	0.004123	ft/ft

From Well # 2 to Manfold
Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\frichpi.fm2
Worksheet	From well# 1 to manifold vault
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data	
Pressure at 2	23.03 psi
Elevation at 1	270.00 ft
Elevation at 2	301.00 ft
Length	2,825.00 ft
C Coefficient	150.0
Diameter	12.00 in
Discharge	1,500.0 gal/min

Results		
Pressure at 1	41.52	psi
Headloss	11.65	ft
Energy Grade at 1	366.05	ft
Energy Grade at 2	354.40	ft
Hydraulic Grade at 1	365.77	ft
Hydraulic Grade at 2	354.12	ft
Flow Area	0.79	ft ²
Wetted Perimeter	3.14	ft
Velocity	4.26	ft/s
Velocity Head	0.28	ft
Friction Slope	0.004123	ft/ft

From Manifold to Heat Exchanger Worksheet for Pressure Pipe

Project Description	
Project File	c:\haestad\fmw\frichpi.fm2
Worksheet	From well# 1 to manifold vault
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data	
Pressure at 2	21.26 psi
Elevation at 1	301.00 ft
Elevation at 2	302.00 ft
Length	2,495.00 ft
C Coefficient	150.0
Diameter	20.00 in
Discharge	3,000.0 gal/min

Results		
Pressure at 1	23.03	psi
Headloss	3.08	ft
Energy Grade at 1	354.27	ft
Energy Grade at 2	351.18	ft
Hydraulic Grade at 1	354.12	ft
Hydraulic Grade at 2	351.04	ft
Flow Area	2.18	ft ²
Wetted Perimeter	5.24	ft
Velocity	3.06	ft/s
Velocity Head	0.15	ft
Friction Slope	0.001236	ft/ft

From Heat Exchanger to Hatchery
Worksheet for Pressure Pipe

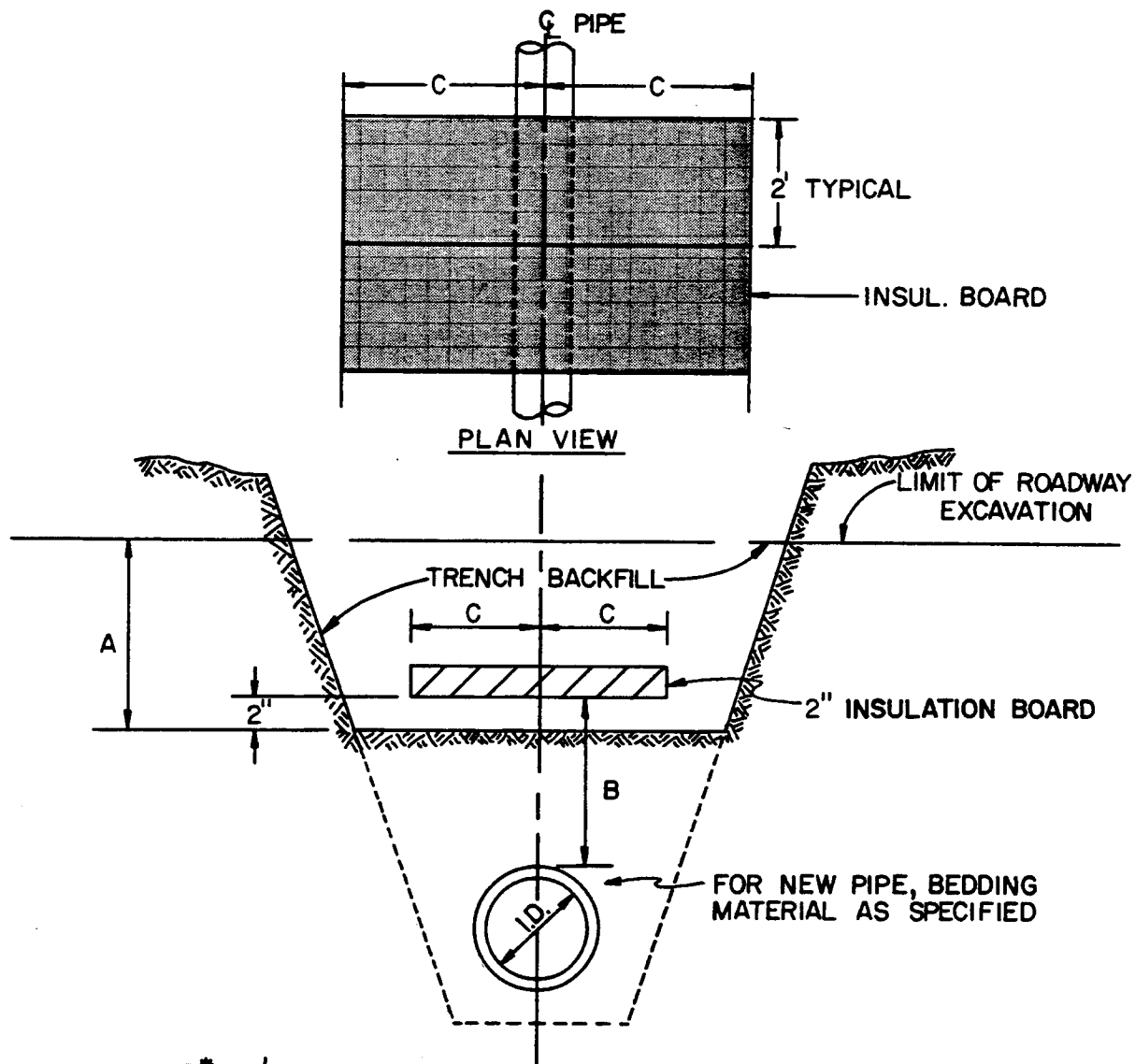
Project Description	
Project File	c:\haestad\fmw\frichpi.fm2
Worksheet	From well# 1 to manifold vault
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data	
Pressure at 2	15.00 psi
Elevation at 1	302.00 ft
Elevation at 2	260.00 ft
Length	8,335.00 ft
C Coefficient	150.0
Diameter	20.00 in
Discharge	3,000.0 gal/min

Results		
Pressure at 1	1.26	psi
Headloss	10.31	ft
Energy Grade at 1	305.05	ft
Energy Grade at 2	294.74	ft
Hydraulic Grade at 1	304.90	ft
Hydraulic Grade at 2	294.60	ft
Flow Area	2.18	ft ²
Wetted Perimeter	5.24	ft
Velocity	3.06	ft/s
Velocity Head	0.15	ft
Friction Slope	0.001236	ft/ft

Appendix F
Cost Estimate
(included on attached CD)

Standard Specifications used to develop cost estimate quantities



B*	C			
	NEW MAIN	EXISTING MAIN	NEW SERVICE CON.	EXISTING SERVICE CON.
1'	2'		1'	
1'to 3'		2'		2'
3'to 5'		3'		3'
5'to 7'		4'		4'

*AS NOTED ON PLANS

A = DEPTH FOR PAYMENT UNDER "TRENCH EXCAVATION AND BACKFILL" WHERE INSULATION IS PLACED OVER EXISTING PIPE

NOTES:

1. THIS DETAIL APPLIES ONLY WHERE INSULATION IS REQUIRED BY THE PLANS.
2. MAXIMUM I.D. = 12"

MUNICIPALITY



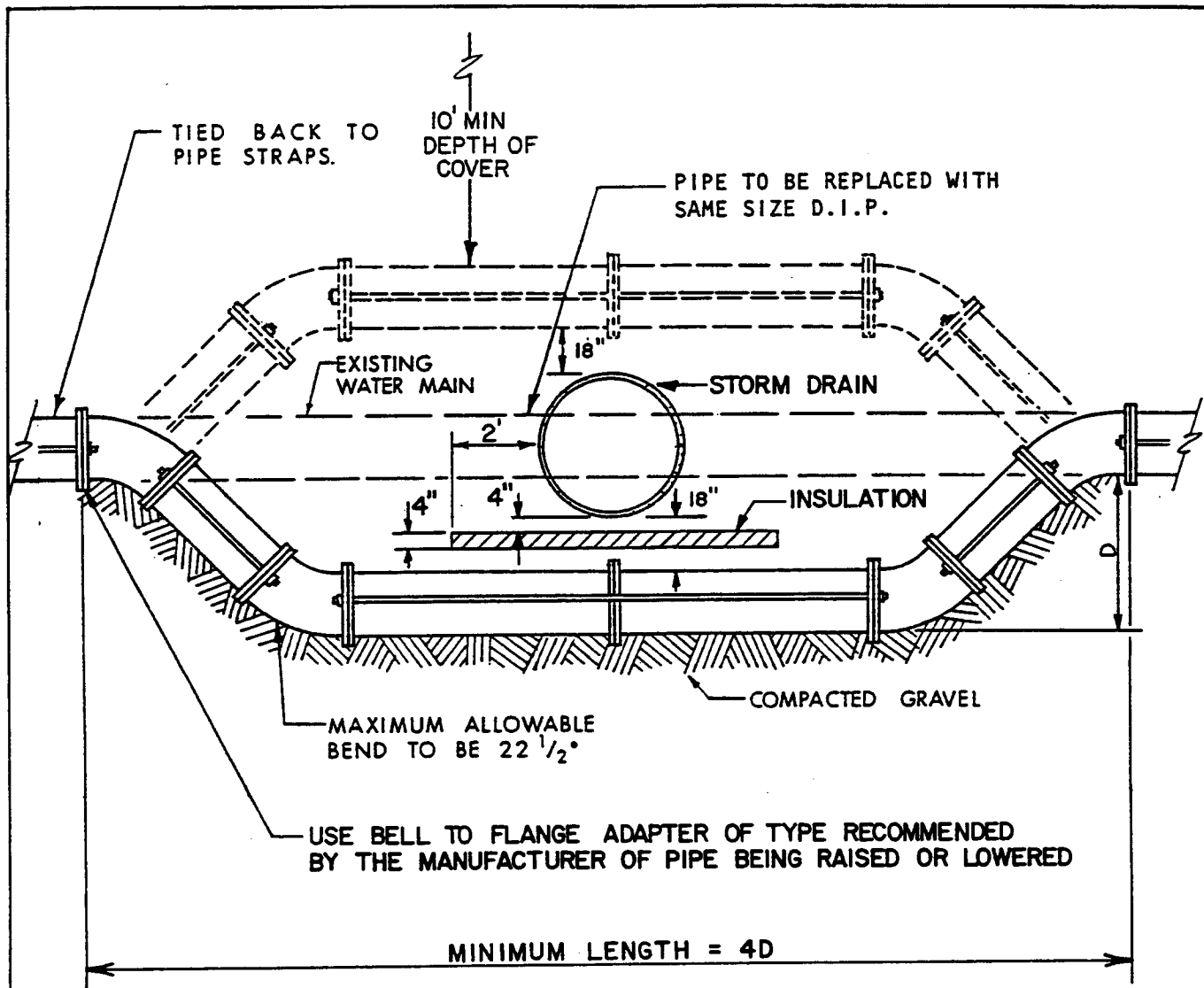
of ANCHORAGE

SCALE:
NTS
APPROVED:

REVISED:
11/87

PIPE INSULATION

SECTION:
70.18
DETAIL #
70-13



NOTES:

1. ALL JOINTS TO BE TIED TOGETHER WITH 3/4" THREADED ROD OR EQUAL.
2. RELOCATED WATER LINE SHALL BE NO LESS THAN (18") DISTANCE FROM STORM SEWER LINE.
3. INSULATION SHALL BE POSITIONED NO LESS THAN (4) FOUR INCHES FROM STORM SEWER.
4. MINIMUM VERTICAL SEPARATION IS (18") EIGHTEEN IN. UNLESS INSULATED WITH (4) FOUR INCHES OF RIGID BOARD INSULATION IN CONFORMANCE WITH SECTION 70.18 INSULATION. (2" STOCK WITH OVERLAPPING JOINTS)

MUNICIPALITY



of ANCHORAGE

SCALE:

NTS

APPROVED:

REVISED:

11/87

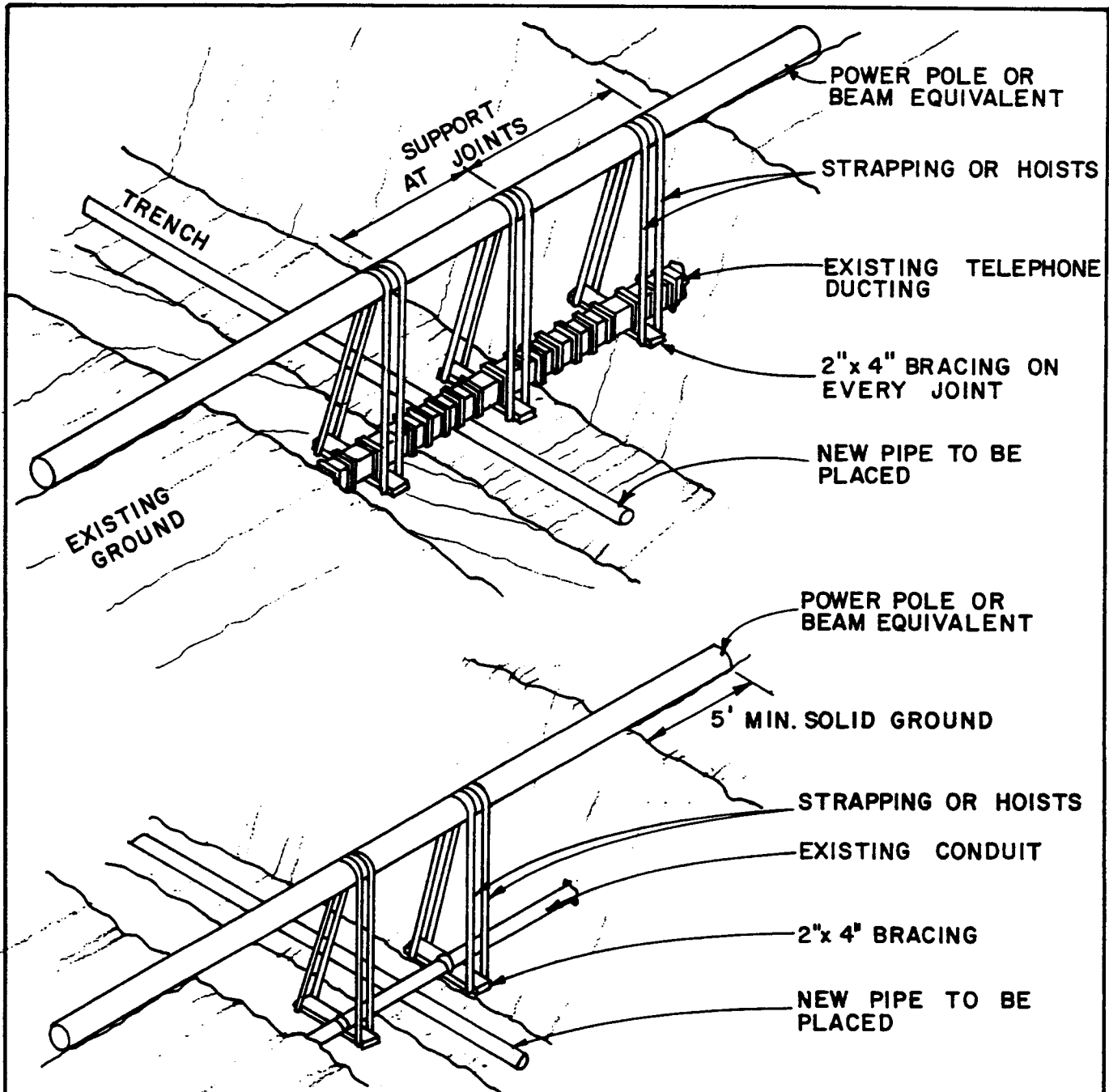
RELOCATE WATER MAIN (STORM DRAIN)

SECTION:

70.17

DETAIL #

70-H



NOTES:

1. SUPPORT DUCTS WITH 2" x 4" AND STRAPS AT JOINTS BEFORE EXCAVATING UNDER DUCTS.
2. THE REPLACING OF CLASSIFIED MATERIAL UNDER DUCT BANK TO BE COMPACTED UP TO WITHIN 18" OF DUCT. THE LAST 18" TO BE CONCRETE OR CONCRETE SLURRY.
3. DUCTS TO BE ENCASED IN 3" OF SAND (ON ALL SIDES).

MUNICIPALITY



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SCALE:

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APPROVED:

REVISED:

11/87

**STANDARD METHOD FOR SHORING
(SUPPORTING) PHONE DUCT/CONDUIT**

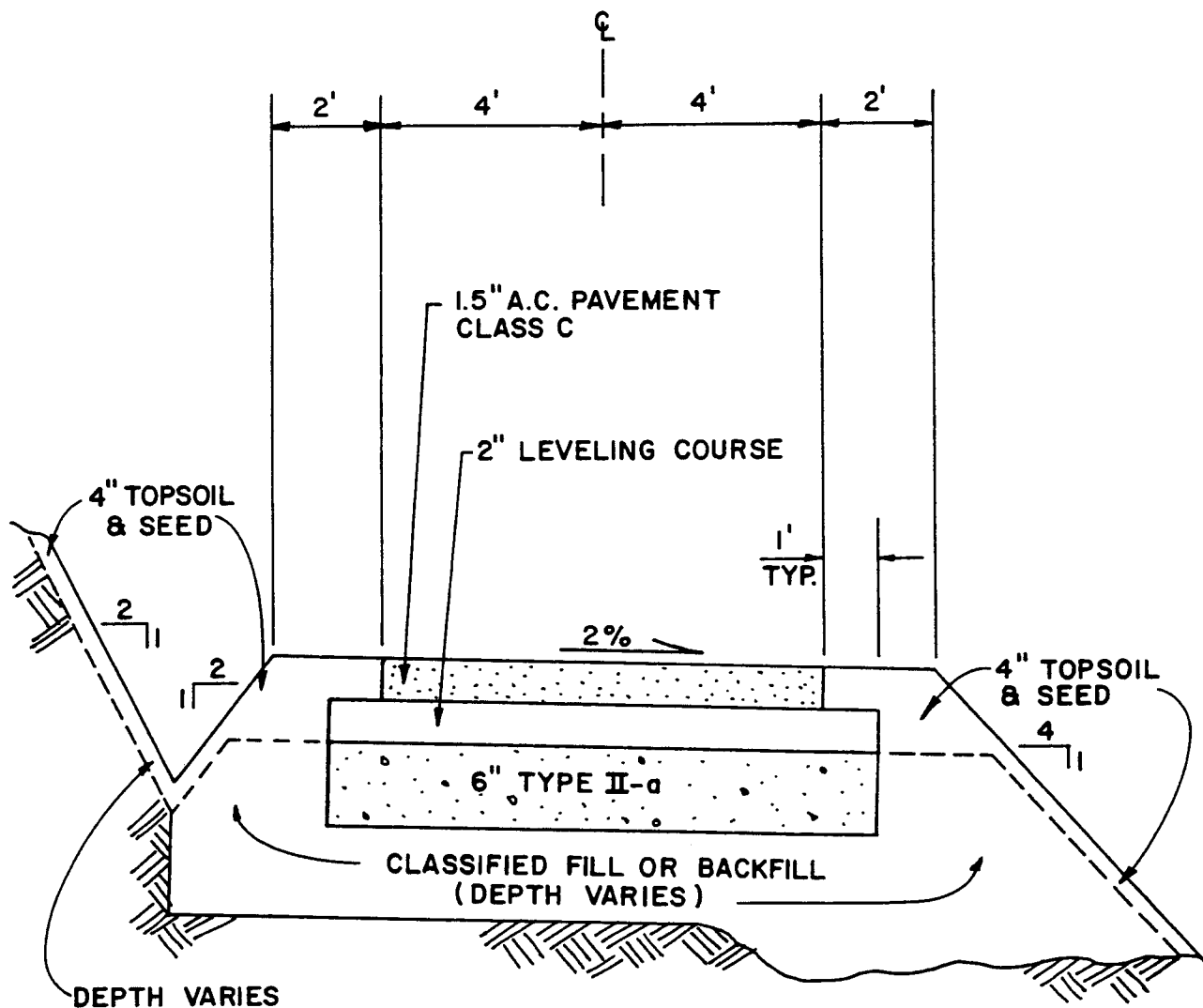
**A.T.U. APPROVED METHOD
& PROCEDURES #86-1**

SECTION#

MISC.

DETAIL#

70-21



NOTES:

1. DEPTH OF CLASSIFIED FILL OR BACKFILL TO BE DETERMINED BY THE ENGINEER.
2. DEPTH OF DITCH SHALL BE AS NECESSARY FOR POSITIVE DRAINAGE AS DIRECTED BY THE ENGINEER.
3. CROSS CULVERTS SHALL BE PLACED AS DIRECTED BY THE ENGINEER.

MUNICIPALITY



of ANCHORAGE

SCALE:

NTS
APPROVED:

REVISED:

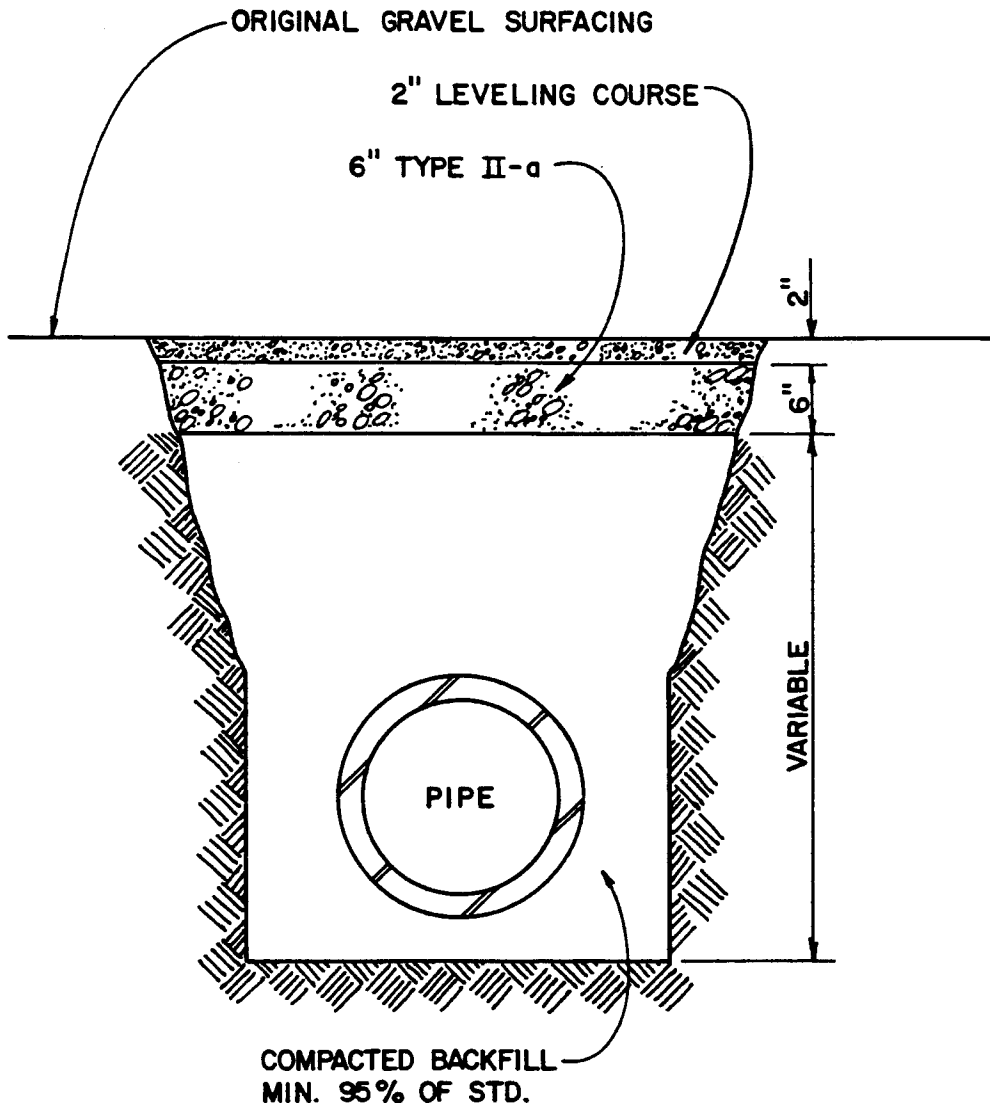
11/87

TYPICAL BIKE TRAIL

SECTION#

20.01
thru 20.14
DETAIL#

20-6



MUNICIPALITY



of ANCHORAGE

SCALE:

NTS

APPROVED:

REVISED:

11/87

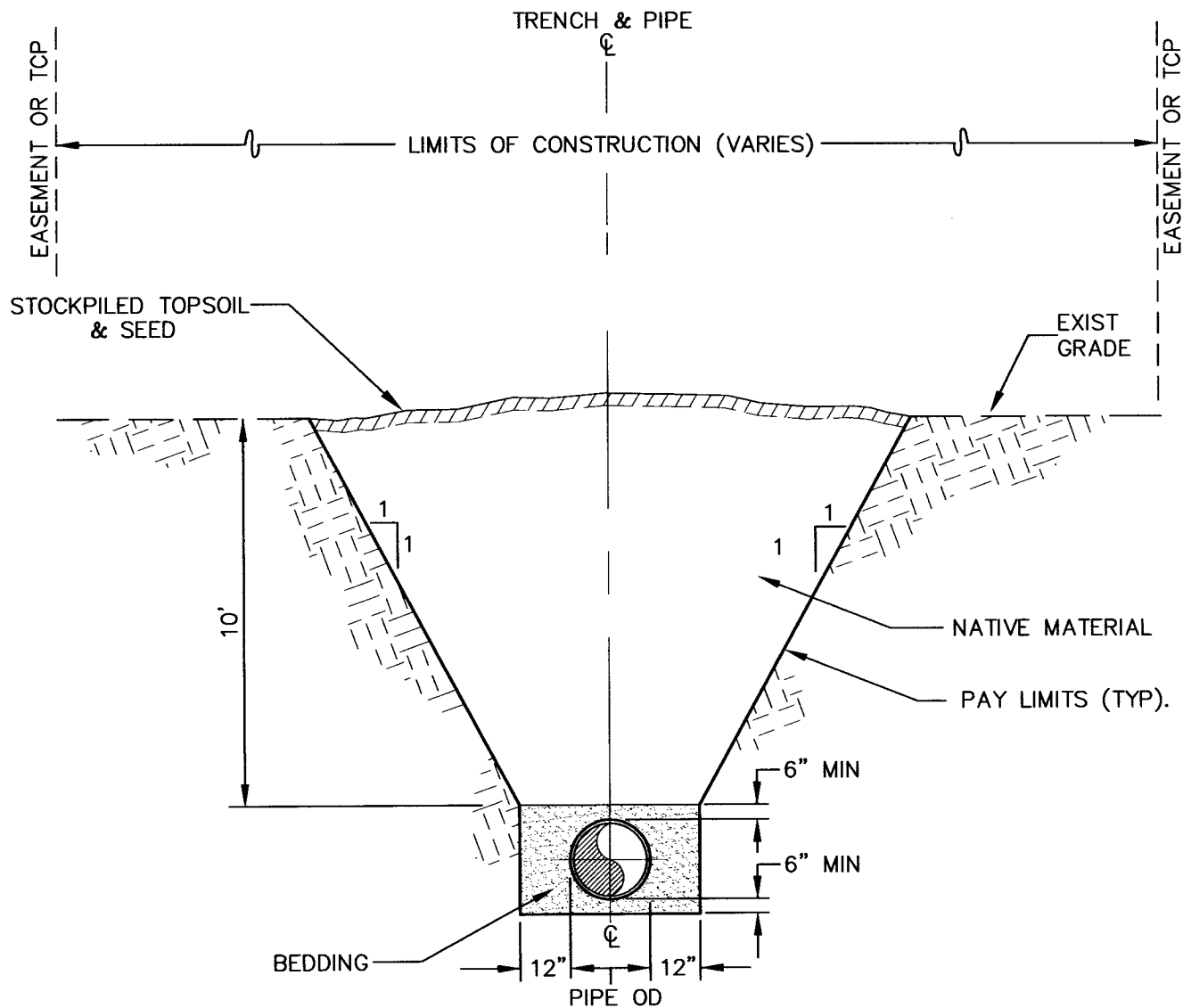
RESURFACING DETAIL TYPICAL GRAVEL SECTION

SECTION#

40.07

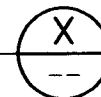
DETAIL#

40-1



TYPICAL TRENCH SECTION

NTS



ALASKA DEPARTMENT OF FISH & GAME
DIVISION OF SPORT FISH
FORT RICHARDSON HATCHERY

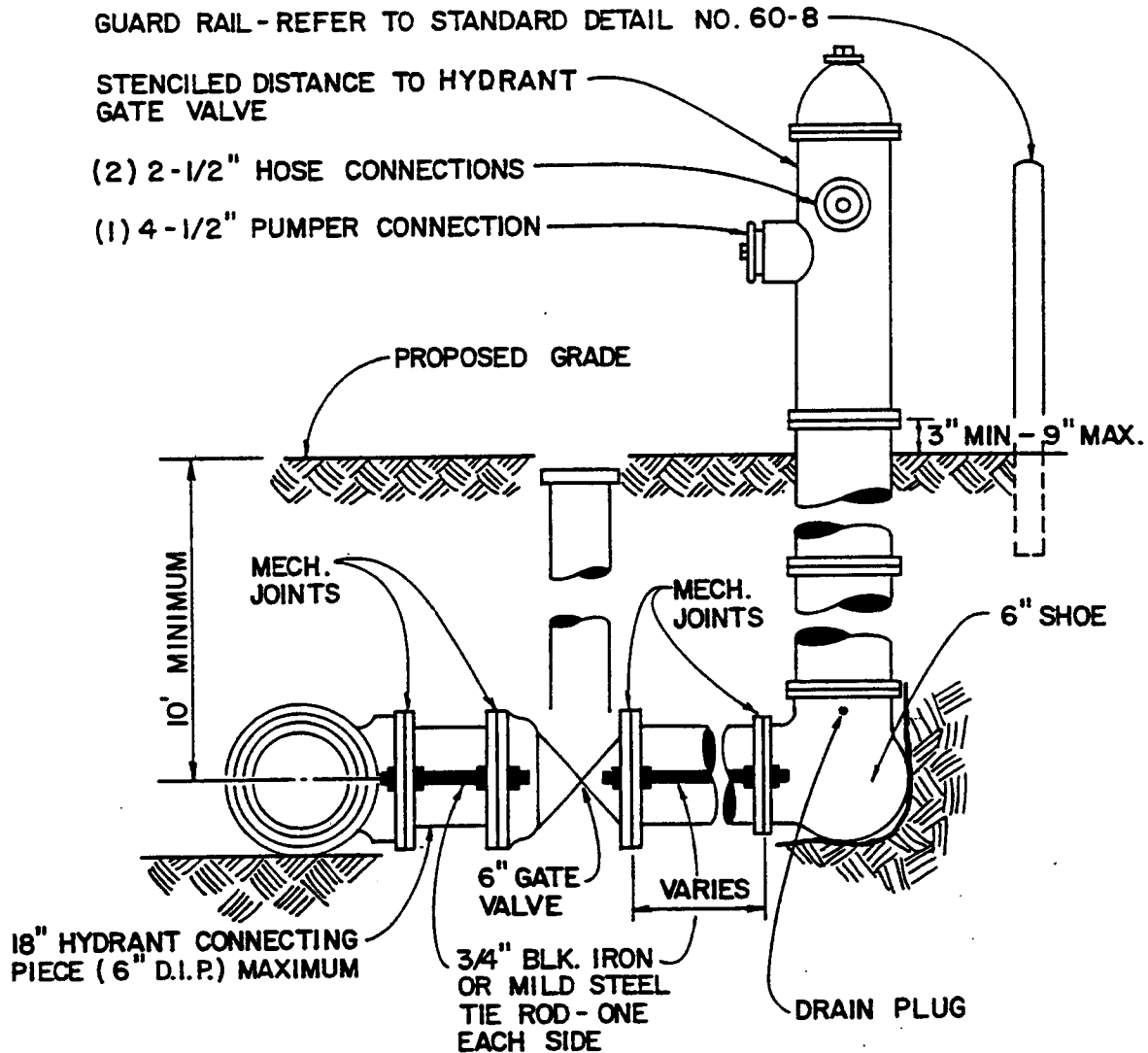
HEATED WATER PIPELINE EVALUATION TYPICAL TRENCH SECTION CONCEPT DESIGN

Date

June 2003

Figure

1.0



HYDRANT INSTALLATION NOTES:

1. HYDRANT BARREL MUST BE INSTALLED PLUMB AND THE LEG MUST BE INSTALLED LEVEL.
2. DRAIN PLUG TO BE INSTALLED BY CONTRACTOR.
3. SEE STD. DETAIL 60-9 FOR LOCATION.
4. ALL HYDRANTS SHALL BE PAINTED CATERPILLAR YELLOW.
5. AUXILIARY GATE VALVE BOX TO BE INSTALLED ACCORDING TO DETAIL FOR TYPICAL VALVE BOX.
6. VALVES SHALL BE TIED TO THE MAIN LINE AND HYDRANT'S SHALL BE TIED TO THE VALVE.

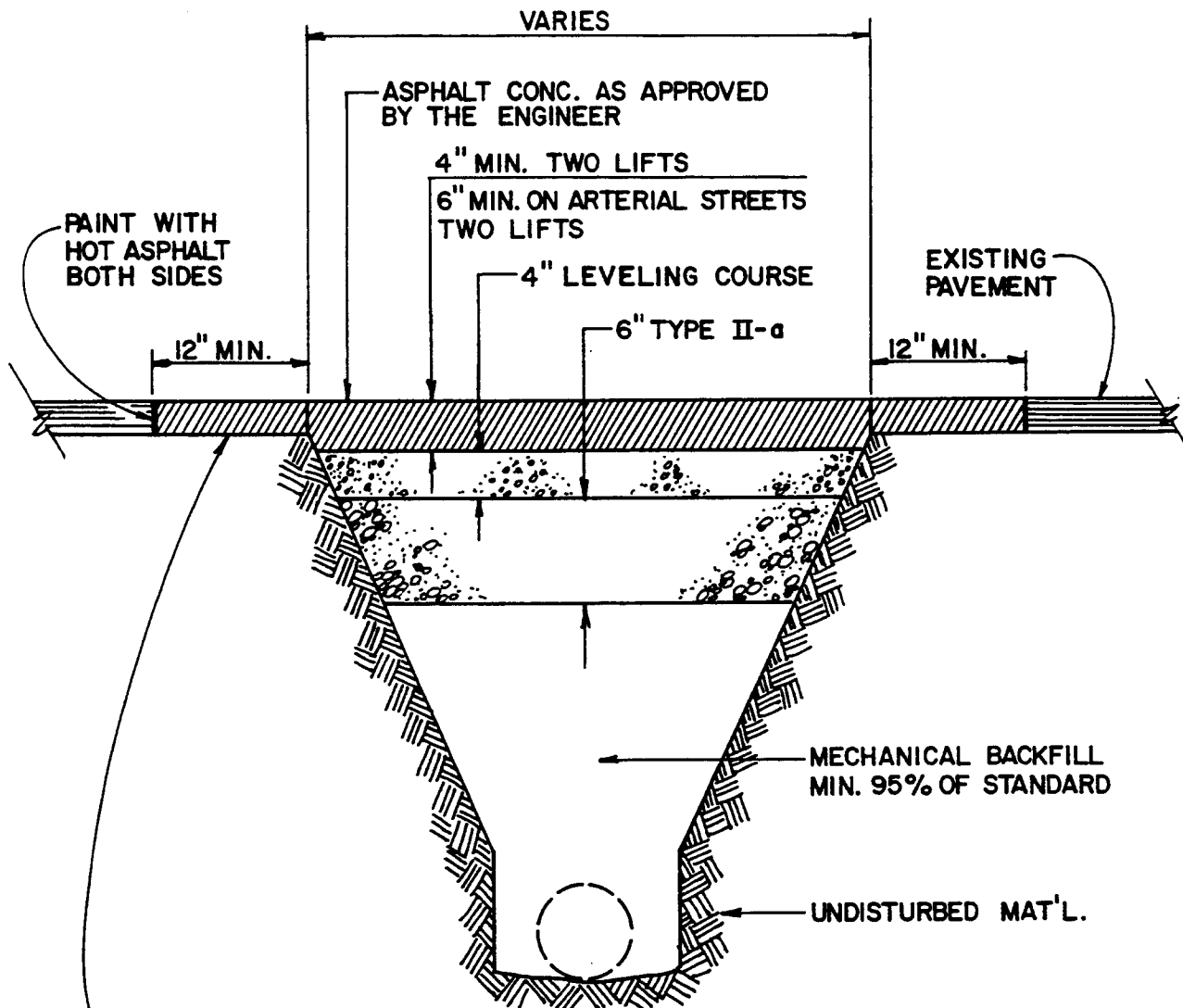


SCALE:
NTS
APPROVED:

REVISED:
11/87

SINGLE PUMPER "L" BASE HYDRANT ASSEMBLY

SECTION:
60.04
DETAIL #
60-6



AFTER DITCH BACKFILL HAS BEEN COMPACTED AN ADDITIONAL 12" WILL BE REMOVED FROM EACH EDGE OF THE ORIGINAL CUT. THE ENGINEER MAY REQUIRE MORE THAN A 12" ADDITIONAL CUT IF THE EXISTING PAVEMENT HAS BEEN LIFTED IN THE REMOVAL PROCESS OR IF THE JOINT DOES NOT OCCUR ON UN-DISTURBED MATERIAL. CUTS MAY BE MADE WITH A SAW OR AIR CHISEL.

MUNICIPALITY



of ANCHORAGE

SCALE:

NTS
APPROVED:

REVISED:

11/87

PAVEMENT CUT REPLACEMENT

SECTION#

40.07

DETAIL#

40-3

Attachment I
Well Field Information

December 11, 2002

HDR Alaska, Inc.
2525 C Street, suite 305
Anchorage, AK 99503-2639

Attn: Mike Wolski

**RE: EVALUATION OF PUMPING TEST DATA, PROPOSED FORT RICHARDSON
FISH HATCHERY WELL FIELD, ANCHORAGE, ALASKA**

In support of the on-going feasibility assessment to construct a well field in the vicinity of the Municipal Light & Power (ML&P) Sullivan Power Plant, Shannon & Wilson has prepared this letter report. This letter report presents the results of the test hole drilling and preliminary well testing activities conducted between July and September 2002. The objectives of this work were to investigate the nature and extent of the aquifer east of the ML&P Sullivan Power Plant and to analyze the results of pumping tests performed at one of the test wells and an Anchorage Water and Wastewater Utility (AWWU) water supply well located adjacent to the power plant.

The proposed well field is located on an unspecified portion of federal property which is managed by the Bureau of Land Management (BLM) and used by the U.S. Army for a training area (Figure 1). HDR Alaska coordinated access to the property and facilitated the receipt of land/resource use permits. Alpine Drilling, Inc. performed the test hole drilling, constructed and developed the test wells, and performed the test pumping of one of the wells. AWWU cooperated in the effort by pumping Well #9 for a period of approximately 30 days so drawdown could be monitored in the test wells. Shannon & Wilson installed pressure transducers and data loggers at each of the test well locations and analyzed the data from the drilling and test pumping. The results of our evaluation are summarized below.

Test Well Installation

Between June 25 and July 1, 2002, Alpine Drilling, Inc. drilled and installed four 6-inch-diameter test wells at the locations shown in Figure 2. Three of the test wells were drilled to a depth of approximately 160 feet below ground surface (bgs) and one was extended to a depth of about 260 feet to explore the underlying sediments. The test wells were generally targeting the same confined aquifer as encountered in AWWU's Well #9. The confined aquifer tapped by

Well #9 consisted of interbedded sands and gravels and silty/clayey horizons which extended from a depth of approximately 97 to 143 feet. A total of 29 feet of discontinuous screen sections were used to span the principal water-bearing zones within this interval. Based on the boring logs provided by Alpine Drilling, the confined aquifer was encountered from a depth of about 76 to 132 feet bgs in Test Well #1, approximately 94 to 149 bgs feet in Test Well #2, and approximately 84 to 113 feet bgs in Test Well #3. The aquifer may be unconfined at Test Well #4 and extended from about 26 to 157 feet. Copies of the boring logs are provided in Attachment 1 at the end of this report.

Test Pumping

Test pumping of Test Well #3 began on July 30 and stopped on August 1, 2002 for a total test period of about 48 hours. The well was pumped at a rate of approximately 275 gallons per minute (gpm) and water levels were monitored in each of the test wells, including Test Well #3. Test Well #3 experienced about 23 feet of drawdown within approximately 3 hours and maintained this level of drawdown for the duration of the 48-hour test. Maximum drawdowns of 1.04 feet in Test Well #2 and 0.27 feet in Test Well #4 were recorded. The water level data from Test Well #1 suggests a maximum drawdown of about 0.20 feet in that well also but fluctuations of this magnitude were observed within 24 hours prior to the test so the data could reflect natural conditions. Following the end of the test pumping, water levels recovered to static conditions within a few hours. Plots of the water level responses for each of the test wells to pumping at Test Well #3 are included in Charts 1 through 4.

AWWU initiated pumping Well #9 on August 2 and ceased on September 3, 2002. Meter readings taken over a three week period were used to calculate an average flow rate of 1,035 gpm. Shannon & Wilson maintained transducers and data loggers in each of the four test wells and utilized water level data obtained by AWWU through their existing well control system. About 29 feet of drawdown was recorded in Well #9. Maximum drawdowns at Test Wells #1, #2, and #3 were recorded at 5.15 feet, 5.47 feet, and 2.55 feet, respectively. A water level decline of about 0.6 feet was recorded at Test Well #4. Recovery of the wells generally took 3 to 4 days. Plots of the water level responses for each of the test wells to pumping at Well #9 are included in Charts 5 through 8.

Analysis

The subsurface conditions encountered in the test wells indicate the heterogenous nature of the unconsolidated sediments and the aquifer(s). As indicated by the boring logs from the individual test wells, the confined aquifer observed in Test Wells #1, #2, and #3 varies in thickness. Additionally, observations by Alpine Drilling during the test well installations noted variations of grain size distribution within the aquifer (water-bearing units) itself with finer grained sediments generally encountered within the confined aquifer sequence of Test Well #2. Although Test Well #2 apparently contained finer grained sediments in the confined aquifer, the potential thickness of the confined aquifer was the greatest in this well with about 82 feet of overall aquifer thickness. Aquifer thickness at Test Wells #1 and #3 were about 56 feet and 29 feet, respectively. As mentioned in a previous section, the aquifer at Test Well #4 may be unconfined with an overall thickness up to about 130 feet. The results of these observations suggest the greatest thickness of aquifer is located in the vicinity of Test Well #4.

The constant rate pumping tests performed at Test Well #3 and AWWU Well #9 provided a preliminary look at the aquifer characteristics. The pump test data was evaluated using nonequilibrium well equations developed by Theis and Jacob. Both water level drawdown and recovery data were utilized, as available, to estimate the transmissivity and storage coefficient of the aquifer. In general, the drawdown curves for the pumping wells, as well as the monitoring wells, exhibited evidence of recharge to the aquifer. The slope of the time-drawdown curves decreased in each of the plots. The cause of this apparent recharge is not specifically known but may be related to the variability of the individual water-bearing horizons in both areal and vertical extent, variations in grain size distribution (ie hydraulic conductivity), and leakage from saturated zones above or below the aquifer. Analysis of the data from Test Wells #2, #3, and #4 during the testing of Test Well #3 generated transmissivities ranging from 12,000 gallons per day per foot (gpd/ft) to 270,000 gpd/ft and storage coefficients ranging from 1.7×10^{-4} to 9.3×10^{-4} . The responses at Test Wells #2, #3, and #4 to the pumping at Well #9 yielded transmissivities that ranged from 18,000 gpd/ft to 390,000 gpd/ft. Primarily utilizing the data derived from the pumping of Test Well #3, an average transmissivity of 104,000 gpd/ft and storage coefficient of 2.11×10^{-4} was determined.

The transmissivity and storage coefficient determined by the pumping test at Test Well #3 is similar to the aquifer parameters previously determined at Well #9. A pumping test

conducted at AWWU Well #9 in 1968 yielded a transmissivity of 108,000 gpd/ft and a storage coefficient of 7.23×10^{-5} . Using a transmissivity of 104,000 gpd/ft and storage coefficient of 2.11×10^{-4} , the drawdown at Test Wells #2, #3, and #4 after 30 days of pumping at Well #9 was calculated using Theis' equation and then compared with the observed drawdown at the respective wells. Calculated drawdowns for Test Wells #2, #3, and #4 were 7.19 feet, 6.86 feet, and 6.30 feet respectively. The observed drawdowns at Test Wells #2, #3, and #4 were 5.31 feet, 2.47 feet, and 0.60 feet, respectively. The observed drawdowns ranged from 10 to 74 percent of the estimated drawdown

Conclusions

Based on our review of the test well logs and pumping test data, we offer the following opinions. The subsurface conditions identified by the test well borings indicate a large degree of variability in the overall aquifer thickness and individual water-bearing horizons. This is attributed to the glacio-fluvial environment in which the sediments were deposited. The aquifer at Test Wells #1 and #3 consisted of a single unit approximately 56 feet and 29 feet thick, respectively, while the aquifer at Test Wells #2 and #4 encompassed approximately 82 and 130 feet, respectively, of stratified water-bearing units separated by lower permeability units. The aquifer at Test Well #3 was observed to be the thinnest.

Pump testing at Test Well #3 produced 275 gpm with about 23 feet of drawdown for a specific capacity of about 12 gpm/ft. This specific capacity is low. Well #9 produced an average of 1,035 gpm with about 29 feet of drawdown for a specific capacity of about 36 gpm/ft. The low specific capacity at Test Well #3 is suspected to be related to well efficiency rather than aquifer performance. It is our opinion that the specific capacity could likely be improved by the use of well screen rather than perforations. Considering the static water level reported at Test Well #3 and the depth of the perforations (a difference of 40 feet), we estimate approximately 400 to 450 gpm could be produced from Test Well #3 without drawing the water level down below the top of the perforations. As noted above, the use of properly installed well screen and well development would be expected to increase the specific capacity by making the well more efficient.

In summary, the subsurface information obtained from the test wells and the results of the pumping tests suggest that a total of 1,500 to 2,000 gpm could be produced from a series of wells constructed within the project area. The pumping test results generated a range for aquifer parameters which are considered suitable for this level of production. Water level responses during the pumping tests exhibited evidence of recharge and/or leakage to the aquifer. These recharge and/or leakage effects likely explain the difference between the observed drawdowns at the test wells versus the projected drawdowns. Negative boundaries, such as impermeable zones, an aquifer of limited areal extent, or effects of other pumping wells were not identified within the period of the pump testing. The magnitude of drawdown at Test Wells #3 and #4 (about 2.47 feet and 0.6 feet, respectively) during the pumping at Well #9 suggest that the interference (drawdown) at Well #9 resulting from well field pumping in the Test Well #3 and #4 area may be relatively small.

The potential thickness of the aquifer and limited amount of drawdown observed at Test Well #4 make this well location desirable for continued evaluation. As noted above, the aquifer may be unconfined in this area so the aquifer parameters determined during the pumping tests at Test Well #3 and Well #9 would not characterize the aquifer at Test Well #4. We recommend the installation of a 12-inch-diameter well with well screen in the vicinity of Test Well #4 and the completion of additional aquifer testing. This data will further define the subsurface conditions in this area, as well as provide critical aquifer response data during pumping.

Limitations

The analyses and conclusions contained in this report are based on site conditions as they presently exist and further assume that the explorations and pumping test results are representative of the subsurface conditions across the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the test wells.

Within the limitation of scope, schedule, and budget, the conclusions and recommendations presented in this report were prepared in accordance with generally accepted professional hydrological and geotechnical engineering principles and practices in the area at the time this report was prepared. We make no other warranty, either expressed or implied.

If, during subsequent well installation or development work at the site, subsurface conditions different from those described herein are observed or appear to be present, we should be advised at once so we can review these conditions and reconsider our recommendations, where necessary.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of our conclusions and recommendations considering the changed conditions and time lapse.

This report was prepared for the exclusive use of HDR Alaska. The scope of our services for this report did not include any environmental assessment or evaluation regarding the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around the site.

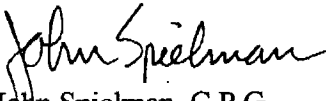
We appreciate the opportunity to work with you on this project. We have prepared the attached "Important Information About Your Geotechnical/Environmental Report" to assist you and others in understanding the use and limitations of our report.

If you have questions or comments related to the contents of this letter, please contact the undersigned.

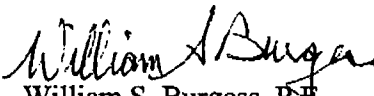
Sincerely,

SHANNON & WILSON, INC.

By:

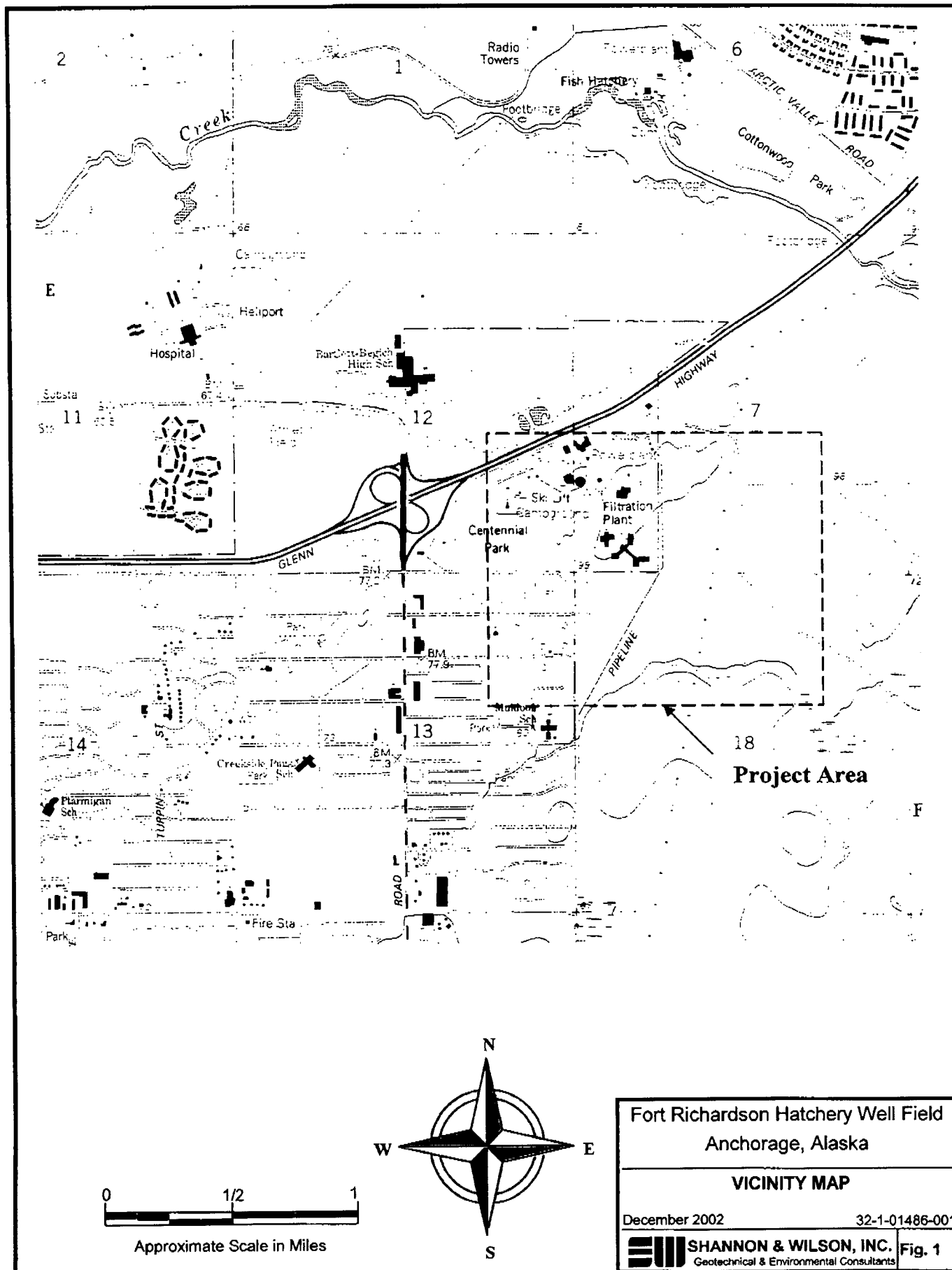

John Spielman, C.P.G.
Principal Hydrogeologist

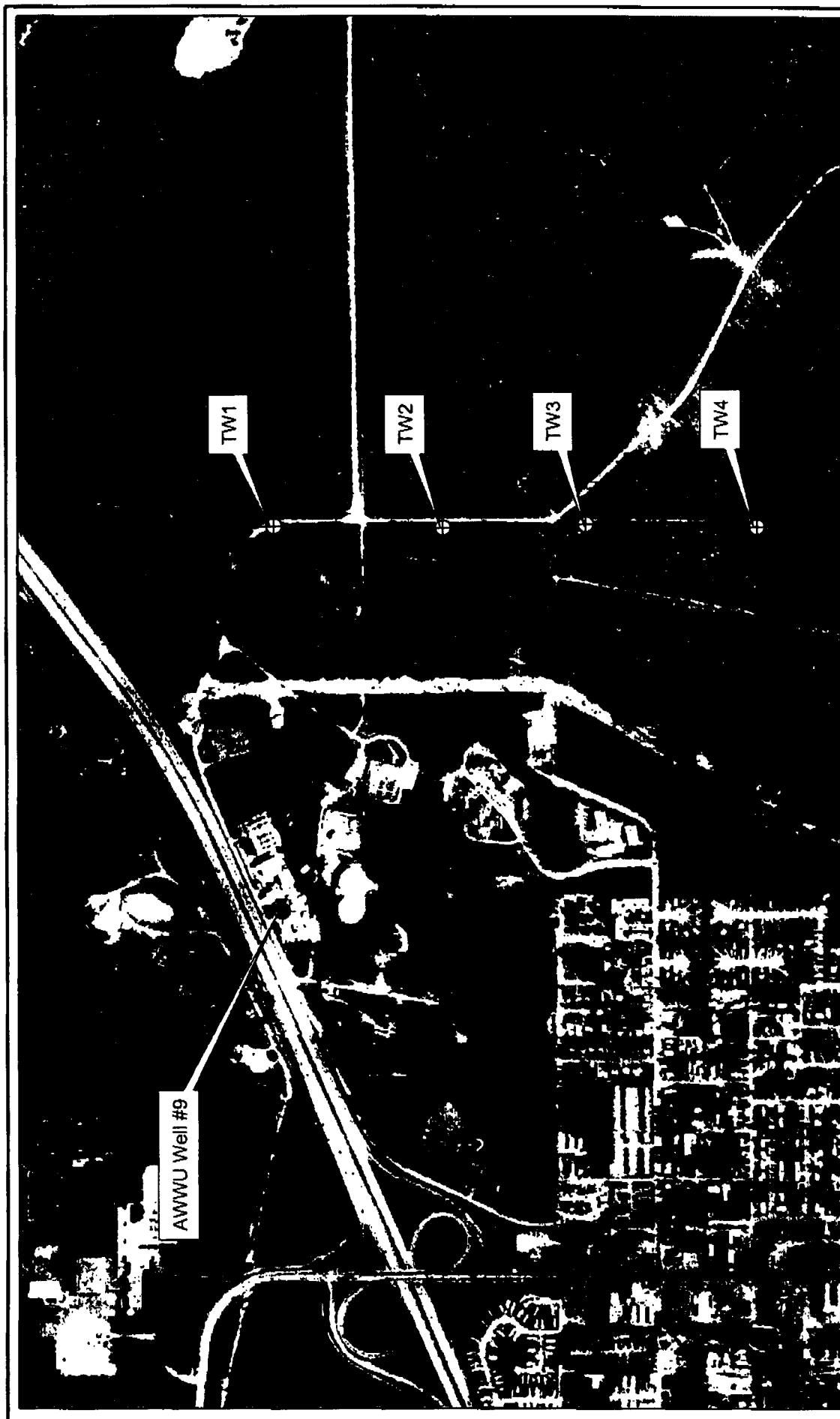
Reviewed By:


William S. Burgess, P.E.
Associate

Encl: Figure 1 – Vicinity Map
Figure 2 – Site Map
Charts 1 through 8 – Drawdown Responses at Test Wells #1 through 4
Attachment A – Test Well Logs
Attachment B – Important Information About Your Geotechnical/ Environmental Report

32-1-01486-001





Fort Richardson Hatchery Well Field
Anchorage, Alaska


SITE MAP

December 2002

32-1-01486

SHANNON & WILSON, INC.
Geotechnical & Environmental Consultants

Fig. 2

 TW1 Test Well installed by Alpine Drilling, Inc.
June 25 to July 1, 2002

Adapted from HDR Alaska Inc. Shapefiles 10/2002

Chart 1 - TW1 Drawdown during TW3 Pumping

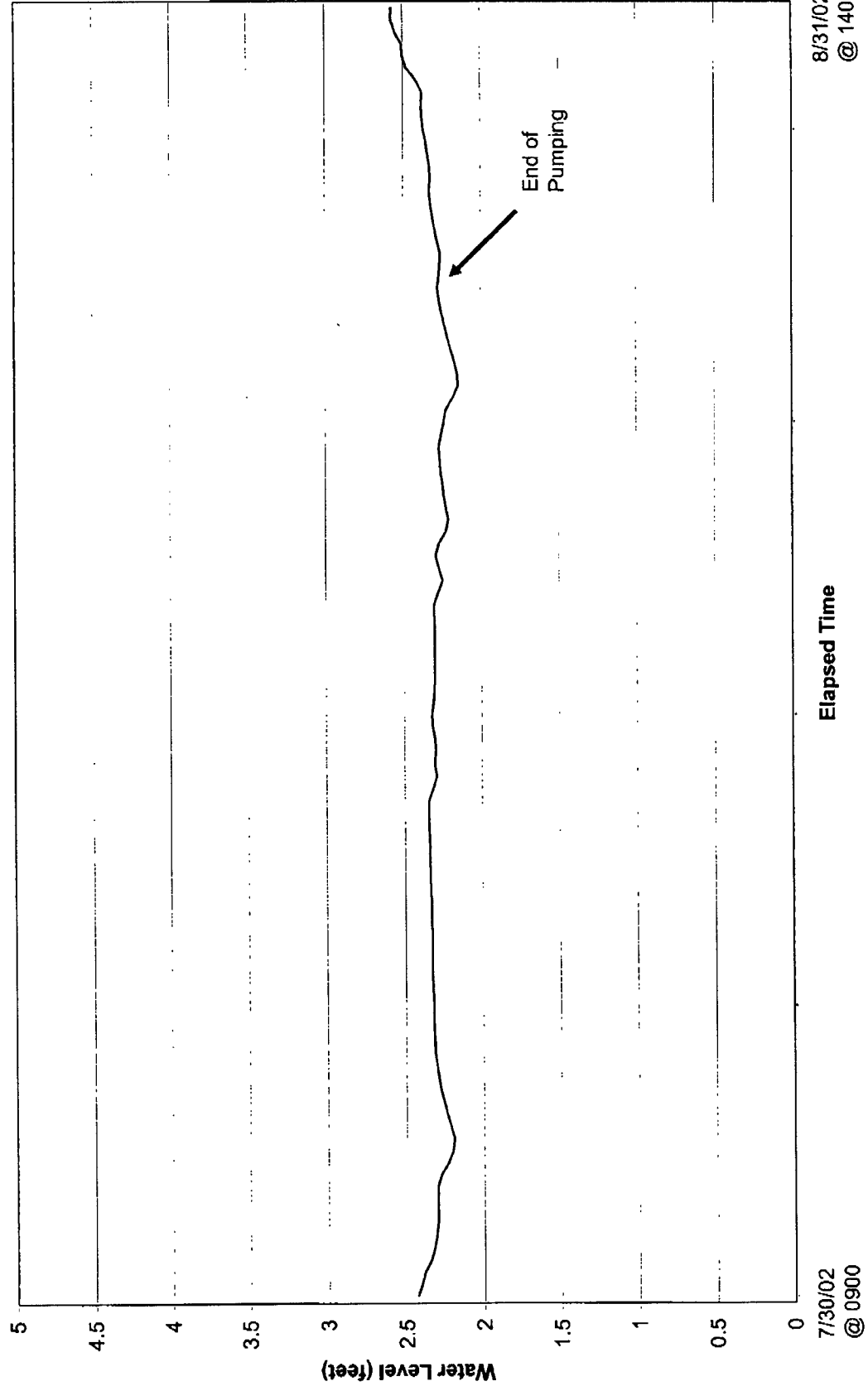
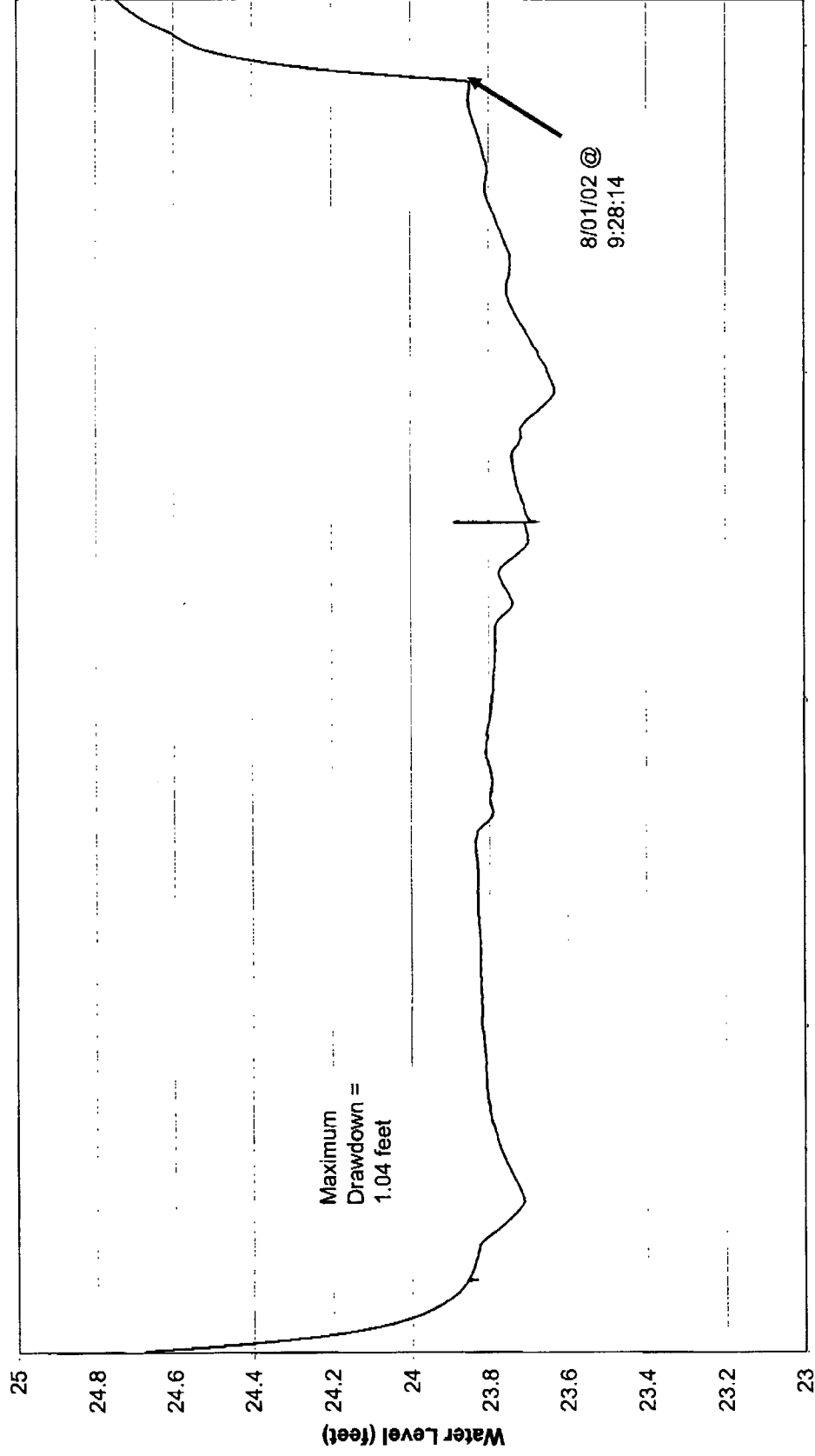


Chart 2 - TW2 Drawdown During TW3 Pumping



Elapsed Time

7/30/02 @
9:24:56

8/01/02 @
13:33:56

Chart 3 - TW3 Drawdown During TW3 Pumping

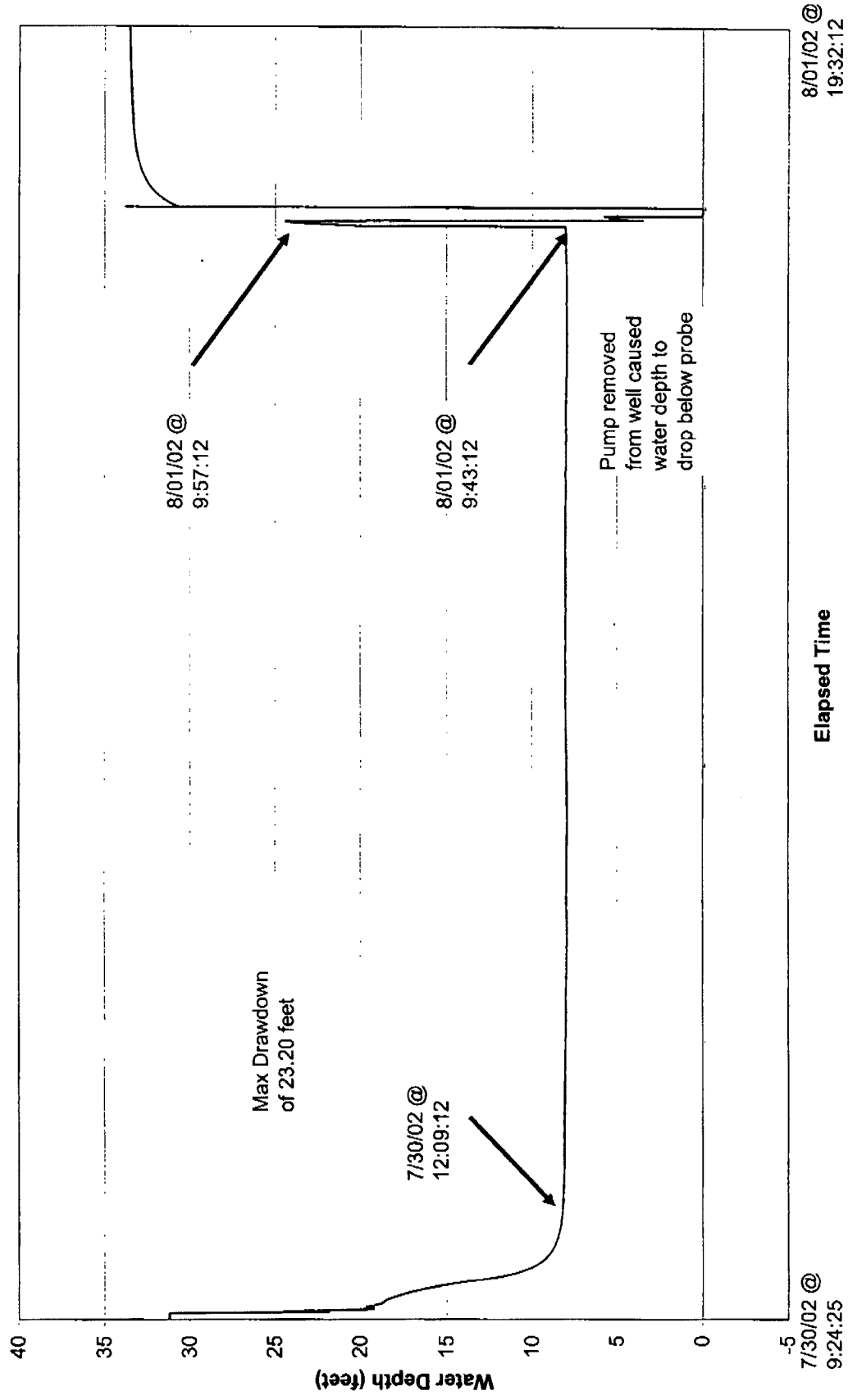


Chart 4 - TW4 Drawdown during TW3 Pumping

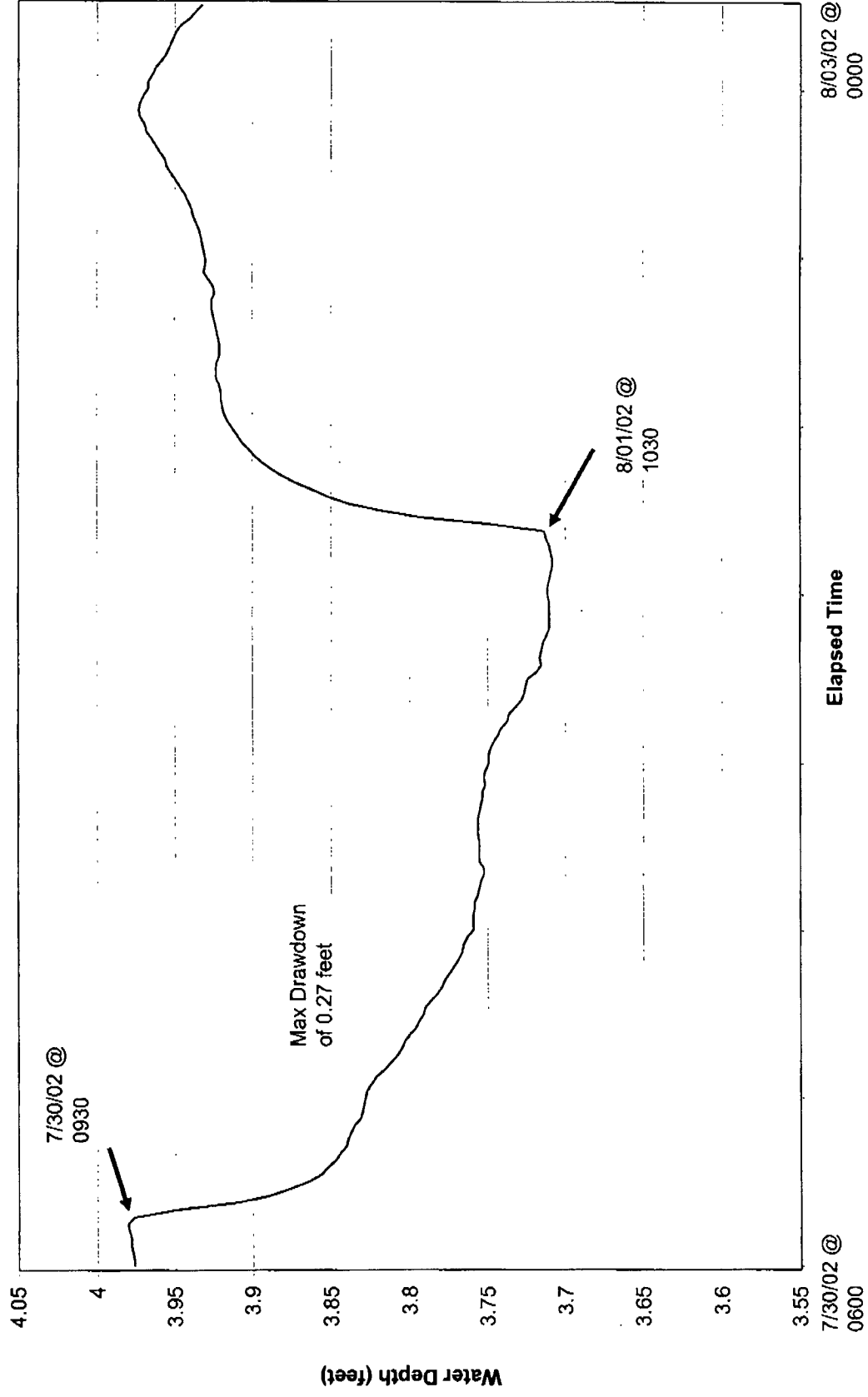


Chart 5 - TW1 Drawdown During AWWU Well #9 Pumping

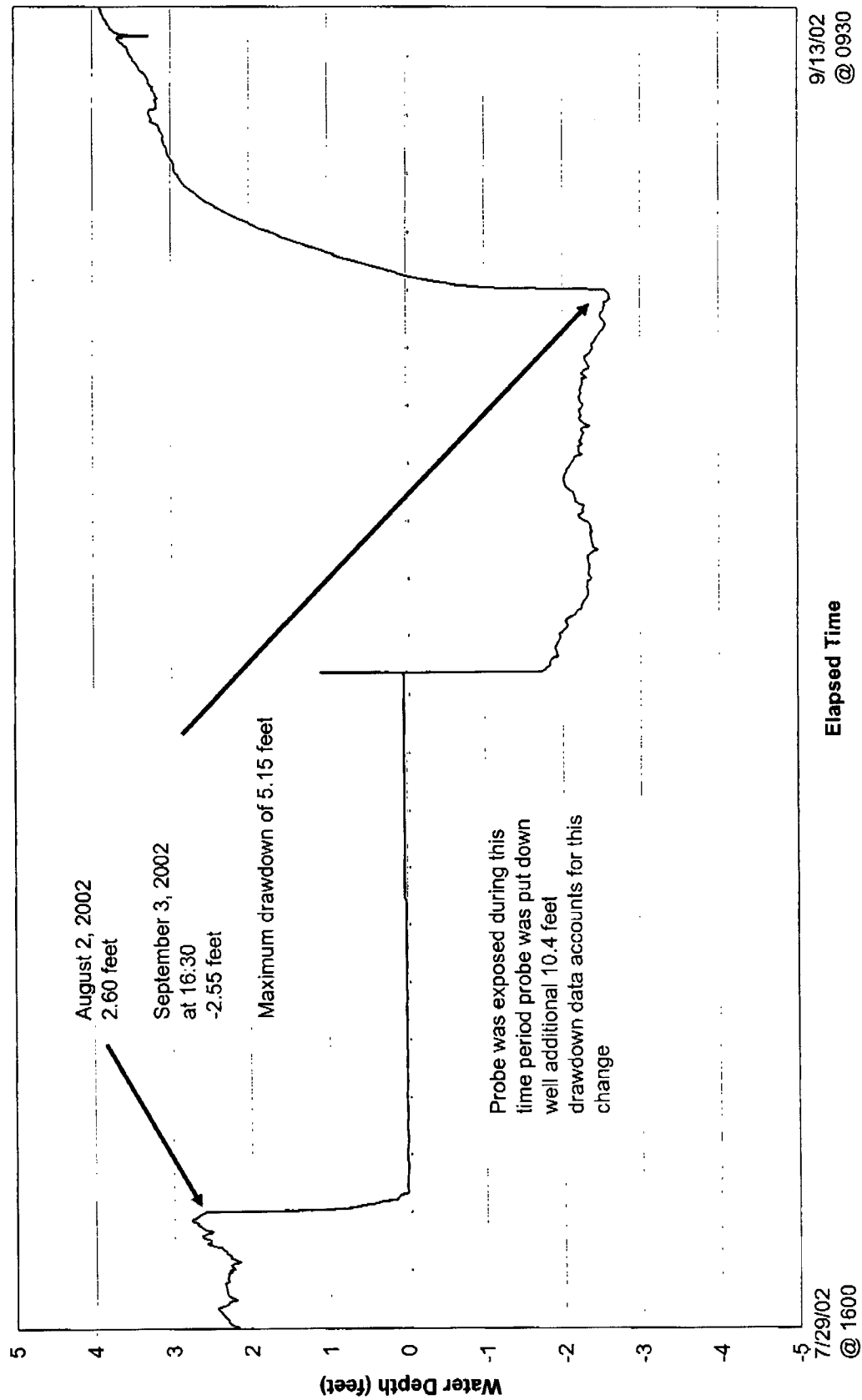


Chart 6 - TW2 Drawdown During AWWU Well #9 Pumping

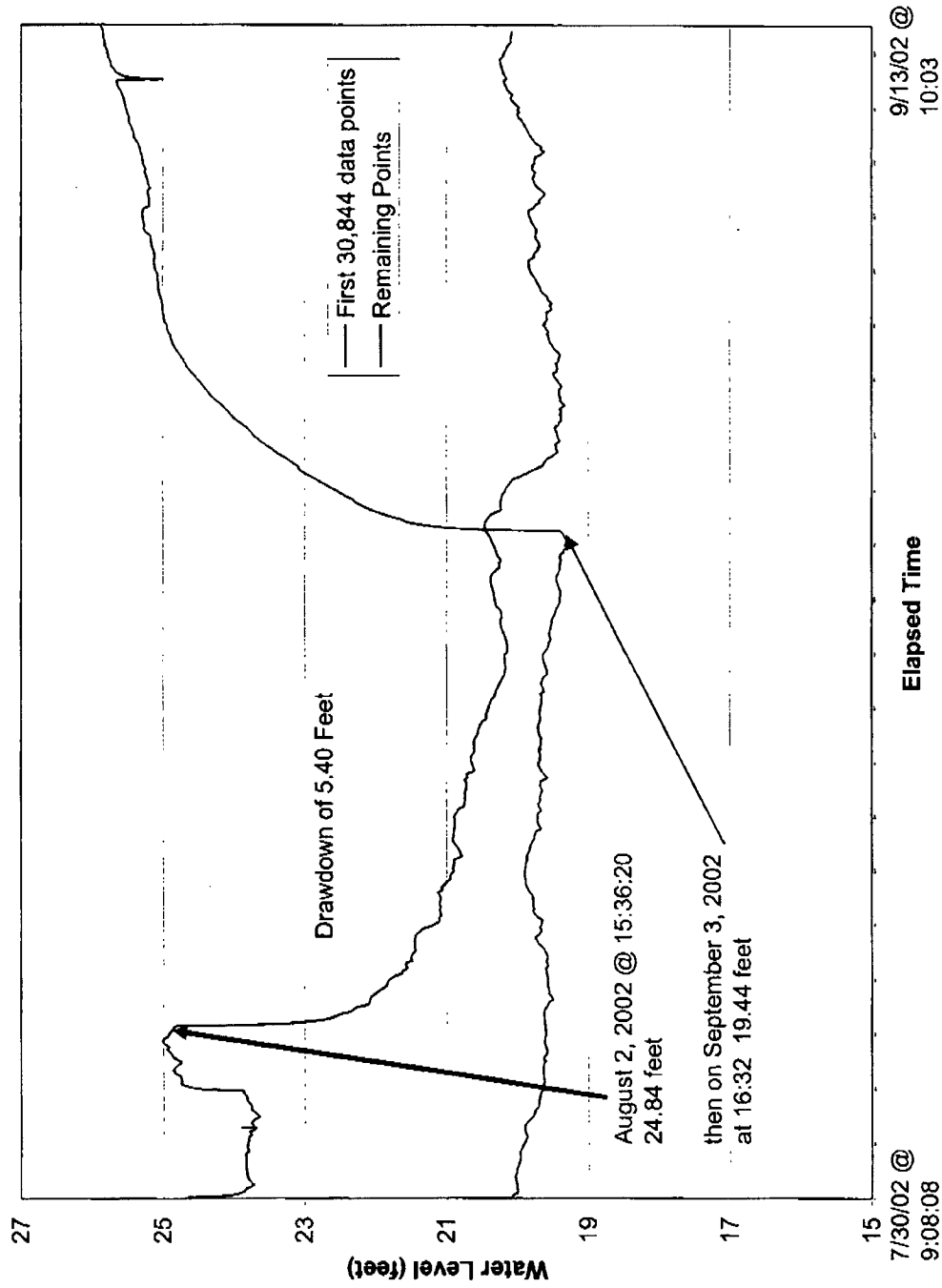
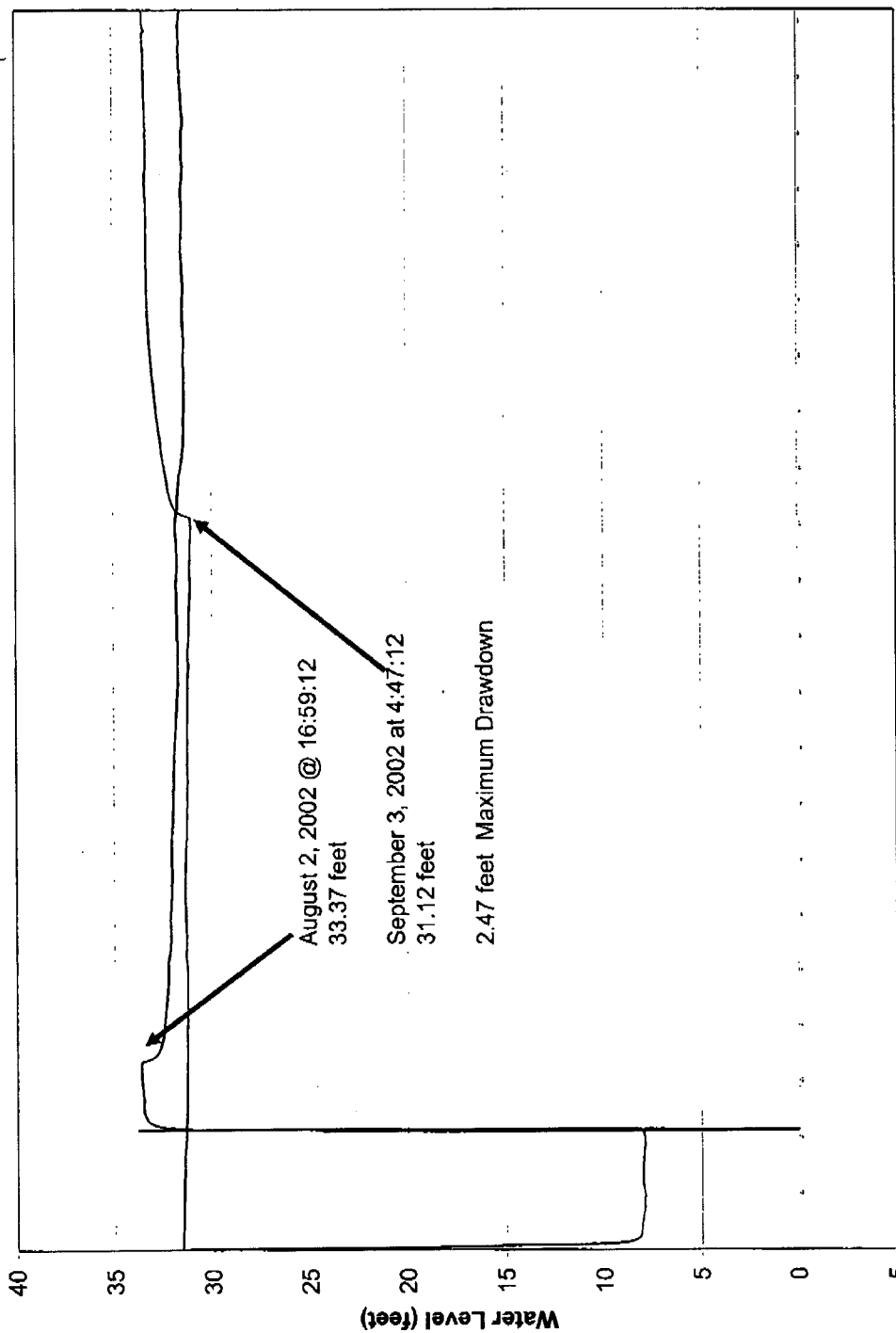


Chart 7 - TW3 Drawdown during AWWU Well #9 Pumping

— First 22.25 Days
— Last 22.89 Days

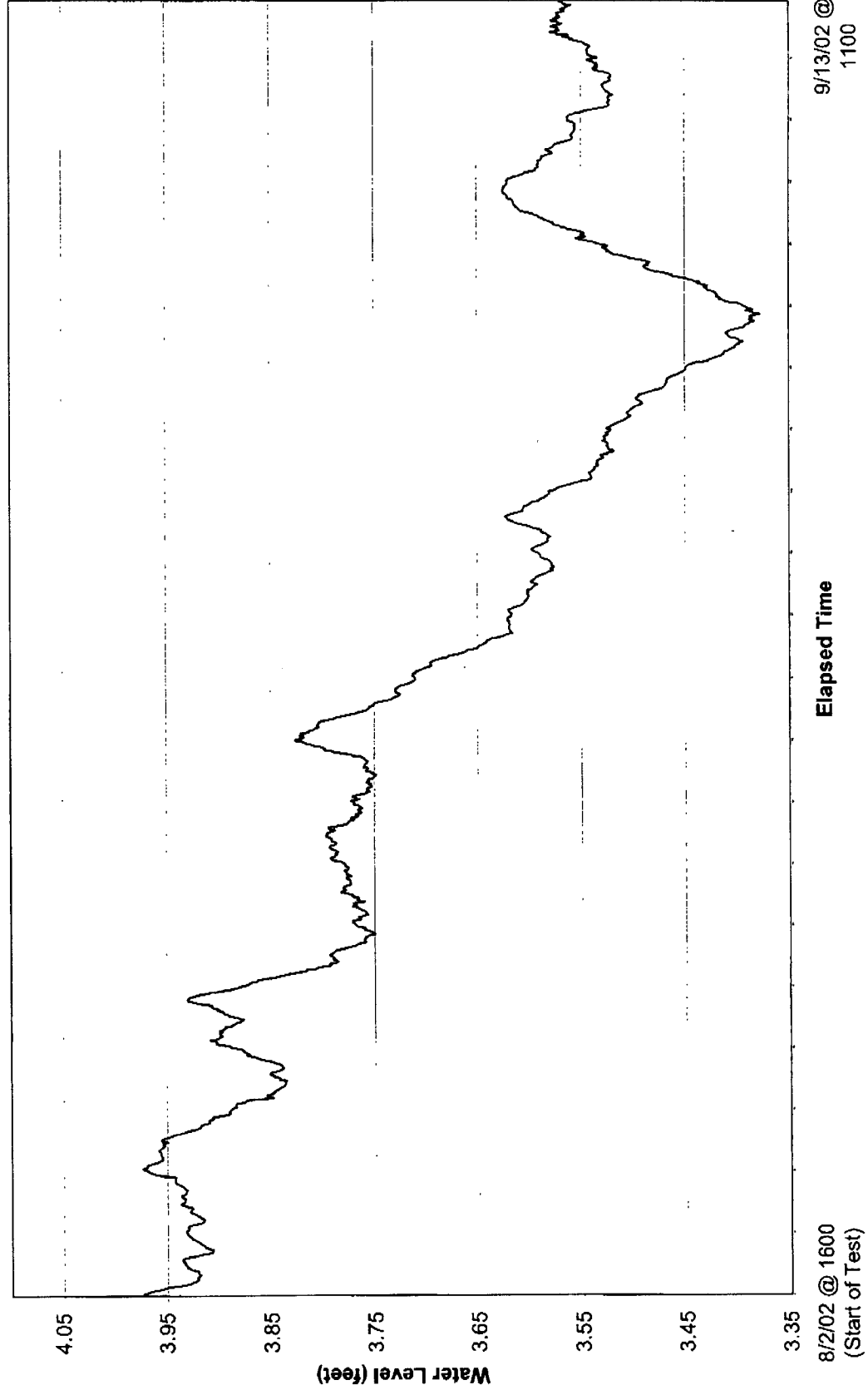


7/30/02 @
9:24:25

Elapsed Time

9/13/02 @
10:25:12

Chart 8 - TW4 Drawdown during AWWU Well #9 Pumping



ATTACHMENT A

Test Well Logs

32-1-01486-001



Rick Mystrom
Mayor

Municipality of Anchorage

Department of Health and Human Services

825 "L" Street

P.O. Box 196850 Anchorage, Alaska 99519-6850

<http://www.ci.anchorage.ak.us>



Permit Number: #SW _____ Date of Issue: _____ Parcel Identification Number: _____
 Date Started: 6-25-02 Date Completed: 6-26-02 Is well located at approved permit location? ☒ Yes ☐ No
 Legal Description: BLM- Fort Richardson, Alaska
 Property Owner Name & Address: ADF&G Fort Richardson Hatchery
Fort Richardson, Alaska
Test Well # 1

Borehole Data:		Depth (ft)		Method of Drilling <input checked="" type="checkbox"/> air rotary <input type="checkbox"/> cable tool	
Soil Type, Thickness & Water Strata		From	To		
stick-up		0	2	Casing type: <u>steel</u>	
sandy cobbly gravelly silt bm		2	14	Wall Thickness: <u>.250</u> inches	
silty cobbly sandy gravel bm moist		14	25	Diameter: <u>6</u> inches Depth: <u>140</u> feet	
gravelly silt bm moist		25	28	Liner Type: _____	
silt bm moist		28	30	Diameter: _____ inches Depth: _____ feet	
silt dry grey		30	56	Casing stickup above ground: <u>2</u> feet	
gravelly silt dry grey		56	58	Static water level (from ground level): <u>70</u> feet	
silt dry grey		58	64	Pumping level: _____ feet after	
silty cobbly gravel dry bm		64	72	_____ hours pumping _____ gpm	
silty sandy cobbly gravel dry moist		72	78	Recovery Rate: _____ gpm	
silty gravel H2O bm est. 300+ gpm		78	134	Method of Testing: <u>air lift</u>	
sandy silt		134	164	Well Intake Opening Type:	
				<input type="checkbox"/> Open End <input checked="" type="checkbox"/> Open Hole	
				<input type="checkbox"/> Screened Start _____ feet Stopped _____ feet	
				<input checked="" type="checkbox"/> Perforations Start <u>85</u> feet Stopped <u>135</u> feet	
				Grout Type: <u>Bentonite granules</u> Volume: <u>1</u> bag	
				Depth: _____ Start <u>0</u> feet Stopped _____ feet	
				Pump: Intake Depth _____ feet	
				Pump size _____ hp Brand Name _____	
				Well Disinfected Upon Completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
				Method of Disinfection: <u>chlorine tablets</u>	
				Comments:	
				Well Driller: <u>Alpine Drilling & Enterprises</u>	
				<u>PO Box 110496</u>	
				<u>Anchorage Alaska 99511</u>	

Attention: The well driller shall provide a well log to the property owner within 30 days of completion and the property



Rick Mystrom
Mayor

Municipality of Anchorage

Department of Health and Human Services

825 "L" Street

P.O. Box 196650 Anchorage, Alaska 99519-0650

http://www.ci.anchorage.ak.us



Permit Number: #SW _____ Date of Issue: _____ Parcel Identification Number: _____
 Date Started: 6-27-02 Date Completed: 6-28-02 Is well located at approved permit location? ☒ Yes ☐ No
 Legal Description: BLM- Fort Richardson, Alaska
 Property Owner Name & Address: ADF&G Fort Richardson Hatchery
Fort Richardson, Alaska
Test Well # 2

Borehole Data:		Depth (ft)		Method of Drilling <input checked="" type="checkbox"/> air rotary <input type="checkbox"/> cable tool	
Soil Type, Thickness & Water Strata	From	To			
stick-up	0	2	Casing type: <u>steel</u>		
silty cobbly gravel bm	2	16	Wall Thickness: <u>.250</u> inches		
silty sandy gravel bm moist	16	28	Diameter: <u>6</u> inches Depth: <u>140</u> feet		
gravelly sandy silt bm moist	28	34	Liner Type: _____		
gravelly sandy silt bm wet	34	52	Diameter: _____ inches Depth: _____ feet		
silt grey dry	52	58	Casing stickup above ground: <u>2</u> feet		
silt bm wet	58	68	Static water level (from ground level): <u>71</u> feet		
gravelly silt grey dry	68	74	Pumping level: _____ feet after		
silt grey dry	74	91	_____ hours pumping _____ gpm		
gravelly silt grey	91	96	Recovery Rate: _____ gpm		
silty gravel bm H2O	96	105	Method of Testing: <u>air lift</u>		
sandy silt bm H2O 30 gpm	105	110	Well Intake Opening Type:		
silty sandy gravel bm H2O 50 gpm	110	115	<input type="checkbox"/> Open End <input checked="" type="checkbox"/> Open Hole		
silty sandy gravel bm clearer H2O	115	118	<input type="checkbox"/> Screened Start _____ feet Stopped _____ feet		
100 gpm	115	118	<input checked="" type="checkbox"/> Perforations Start <u>100-120 & 125-133</u> feet Stopped <u>133</u> feet		
gravelly silt bm wet	118	130	Grout Type: <u>Bentonite granules</u> Volume: <u>1</u> bg		
gravelly sandy cobbly silt bm H2O 50 gpm	130	151	Depth: _____ Start <u>0</u> feet Stopped _____ feet		
gpm boring stays open	151	178	Pump: Intake Depth _____ feet		
gravelly sandy silt bm H2O 30 gpm	151	178	Pump size _____ hp Brand Name _____		
gravelly silt bm moist	178	191	Well Disinfected Upon Completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
sandy silt grey intermittent gr seams	191	263	Method of Disinfection: <u>chlorine tablets</u>		
Comments:					
Well Driller: <u>Alpine Drilling & Enterprises</u> <u>PO Box 110496</u> <u>Anchorage Alaska 99511</u>					

Attention: The well driller shall provide a well log to the property owner within 30 days of completion and the property

FROM : ALPINE DRILLING

FAX NO. : 907 345 0202

Jul. 11 2002 10:13AM P1

Rick Mystrom
Mayor

Municipality of Anchorage

Department of Health and Human Services

825 "L" Street

P.O. Box 198850 Anchorage, Alaska 99519-6650

http://www.ci.anchorage.ak.us



Permit Number: #SW _____ Date of Issue: _____ Parcel Identification Number: _____
 Date Started: 7-1-02 Date Completed: 7-2-02 Is well located at approved permit location? ☒ Yes ☐ No
 Legal Description: BLM- Fort Richardson Alaska
 Property Owner Name & Address: ADF&G Fort Richardson Hatchery
Fort Richardson, Alaska
Test Well #3

Borehole Data:		Depth (ft)		Method of Drilling <input checked="" type="checkbox"/> air rotary <input type="checkbox"/> cable tool	
Soil Type, Thickness & Water Strata	From	To			
stick-up	0	2	Casing type: <u>steel</u>		
organics	2	3	Wall Thickness: <u>.250</u> inches		
silty cobbly gravel bm dry	3	16	Diameter: <u>6</u> inches Depth: <u>140</u> feet		
gravelly silt bm moist	16	22	Liner Type: _____		
cobbly gravel bm	22	34	Diameter: _____ inches Depth: <u>140</u> feet		
silty water sand & gravel bm	34	39	Casing stickup above ground: <u>2</u> feet		
gravelly silt grey moist	39	46	Static water level (from ground level): <u>45</u> feet		
silty water sand & gravel bm	46	53	Pumping level: _____ feet after		
silt bm moist	53	56	_____ hours pumping _____ gpm		
silt grey dry	56	77	Recovery Rate: _____ gpm		
gravelly silt grey dry	77	86	Method of Testing: <u>air lift</u>		
silty water sand & gravel bm 100 gpm	86	115	Well Intake Opening Type:		
sandy gravelly silt bm moist	115	163	<input type="checkbox"/> Open End <input checked="" type="checkbox"/> Open Hole <input type="checkbox"/> Screened Start _____ feet Stopped _____ feet <input checked="" type="checkbox"/> Perforations Start <u>85</u> feet Stopped <u>115</u> feet		
			Grout Type: <u>Bentonite granules</u> Volume: <u>1</u> bag		
			Depth: _____ Start <u>0</u> feet Stopped _____ feet		
			Pump: Intake Depth _____ feet		
			Pump size _____ hp Brand Name _____		
			Well Disinfected Upon Completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
			Method of Disinfection: <u>chlorine tablets</u>		
			Comments:		
			Well Driller: <u>Alpine Drilling & Enterprises</u> <u>PO Box 110496</u> <u>Anchorage Alaska 99511</u>		

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Rick Mystrom
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Department of Health and Human Services

825 "L" Street

P.O. Box 196850 Anchorage, Alaska 99519-6650

<http://www.ci.anchorage.ak.us>

Permit Number: #SW _____ Date of Issue: _____ Parcel Identification Number: _____
 Date Started: 7-1-02 Date Completed: 7-2-02 Is well located at approved permit location? ☒ Yes ☐ No
 Legal Description: BLM- Fort Richardson, Alaska
 Property Owner Name & Address: ADF&G Fort Richardson Hatchery
Fort Richardson, Alaska
Test Well # 4

Borehole Data:		Depth (ft)		Method of Drilling <input checked="" type="checkbox"/> air rotary <input type="checkbox"/> cable tool	
Soil Type, Thickness & Water Strata	From	To			
stick-up	0	2	Casing type: <u>steel</u>		
sandy silty gravel bm dry	2	21	Wall Thickness: <u>.250</u> inches		
gravelly silt bm wet	21	24	Diameter: <u>6</u> inches Depth: <u>160</u> feet		
gravelly silt bm moist	24	28	Liner Type: _____		
sandy silt bm wet	28	37	Diameter: _____ inches Depth: _____ feet		
gravelly silty sand bm wet	37	65	Casing stickup above ground: <u>2</u> feet		
silty sandy gravel bm 50 gpm	65	70	Static water level (from ground level): <u>28</u> feet		
gravelly silt bm moist	70	74	Pumping level: _____ feet after		
silty sandy gravel bm 50 gpm	74	80	_____ hours pumping _____ gpm		
silty sandy gravel bm H2O 100 gpm	80	100	Recovery Rate: _____ gpm		
silty gravelly sand H2O 100 gpm	100	115	Method of Testing: <u>air lift</u>		
sandy silt bm	115	128	Well Intake Opening Type:		
silty gravel H2O bm 50gpm	128	135	<input type="checkbox"/> Open End <input checked="" type="checkbox"/> Open Hole		
gravelly silt bm moist	135	148	<input type="checkbox"/> Screened Start _____ feet Stopped _____ feet		
silty sandy gravel bm H2O	148	159	<input checked="" type="checkbox"/> Perforations Start <u>80</u> feet Stopped <u>159</u> feet		
gravelly silt bm moist	159	163	Grout Type: <u>Bentonite granules</u> Volume: <u>1</u> bg		
			Depth: _____ Start <u>0</u> feet Stopped _____ feet		
			Pump: Intake Depth _____ feet		
			Pump size _____ hp Brand Name _____		
			Well Disinfected Upon Completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
			Method of Disinfection: <u>chlorine tablets</u>		
			Comments:		
			Well Driller: <u>Alpine Drilling & Enterprises</u>		
			<u>PO Box 110496</u>		
			<u>Anchorage Alaska 99511</u>		

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ATTACHMENT B

Important Information About Your

Geotechnical/Environmental Report

32-1-01486-001



Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland